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The Role of the Radiologist in the Management of Patients with Intestinal Obstruction, with Special Reference to the Use of the Miller-Abbott Tube[1]

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THE PURPOSE OF the present study is to evaluate the role of the x-ray examination in the management of patients with intestinal obstruction. In recent years the radiologist's opportunity in this field has been extended by the introduction and increasing use of the Miller-Abbott tube. It is therefore proposed to consider in some detail the use of this tube, with particular reference to the radiological examination. Brief reference will also be made to the over-all improvement in the operative management as a result of the introduction of this surgical adjunct, and pertinent figures will be cited from a series of cases of small intestinal obstruction treated in the Hospital of the University of Pennsylvania over a five-year period.

With the onset of intestinal obstruction, many physiological changes ensue. A thorough understanding of these changes and their variation with the location, degree, duration, and nature of the occlusion are essential if the radiologist is to have a thorough understanding of the surgical problem and thus contribute to its solution. This phase of the subject has been amply covered by Wangensteen (41) and space need not be given it here. The clinical features are likewise well known, and a brief summary of these will suffice.

Except in high obstruction, intestinal colic is the prime manifestation of intestinal occlusion, though in late cases bowel activity may be so reduced that clear-cut colic is recognized with difficulty. Distention invariably results if the obstruction is untreated. It may not, however, be clinically evident in early cases, and it is in the demonstration of its presence at this stage that the x-ray is of particular value. Vomiting is a prompt and persistent symptom of high obstruction and appears in most cases of small intestinal occlusion. It may be entirely absent in closed-loop obstructions of the colon or may be infrequent and of reflex origin. Persistent tenderness, fever, and leukocytosis are suggestive of strangulation. It is particularly important that this possibility be considered, since only if it can be ruled out is it justifiable to resort to suction drainage.

ROENTGEN DIAGNOSIS

While the clinical diagnosis of intestinal obstruction is often adequate, the roentgen examination offers valuable confirmatory evidence and in many cases is useful in de-

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termining the location of the obstruction as well. Without the administration of barium, it is rarely possible to come to any conclusion as to the etiology, but it is never advisable to resort to the use of barium except by enema.

The roentgen examination is best begun with fluoroscopy of the chest or, if this is deemed too distressing to the patient, roentgenography in the upright position. This may disclose possible pulmonary disease, establishing the distention as of reflex origin rather than due to actual obstruction, or it may reveal conditions directly related to an obstructive lesion, as for example the presence of metastatic deposits. An anteroposterior roentgenogram of the abdomen, made with the aid of a Bucky diaphragm, with the patient supine, is most satisfactory for study of the outlines of the gas-filled intestinal loops (and of the undistended feces-filled loops as well). A comparable roentgenogram should also be made with the patient erect.

The interpretation of the roentgen examination should provide, if possible, the answers to the following questions: Is radiographically demonstrable gas[2] present within the intestinal tract and, if so, in what portion or portions? Are the distribution and amount pathologic or within normal limits? If distention is present, is it due to obstruction of the bowel lumen or to other, so-called reflex, causes?[3] If distention is presumably due to obstruction, where is the obstruction? If the distention is presumably reflex, is there anything in the roentgen examination to suggest the etiology?

The earliest roentgen sign of small bowel obstruction is the finding on the survey film of a small segment of distended gut.[4] The outline is clean-cut, and the shape may resemble that of a hairpin, the so-called "hairpin loop." (39; Cases 1 and 2). Such an appearance may be seen as early as four hours after the onset of symptoms (23; 29; Case 1). The erect film in such a case may not show a fluid level in the distended loop. As the obstruction persists, the length of the distended segment increases, and the coils appear greater in diameter and lie transversely in the abdomen, one above the other, producing the "stepladder" pattern. At this time fluid levels are usually seen. In the later stages, the appearance is similar but more marked. (Figs. 1 to 6.) In the earlier stages, the pattern of the distended segment resembles to some degree that of the barium-filled segment, the "feathery" pattern of the jejunum appearing as closely spaced, delicate, transverse striations, due to the valvulae conniventes. The more distal segments of the small intestine become less and less characteristic when distended, the transverse striations becoming less prominent, while the terminal portions of the ileum are, as described by Wangensteen, "characterless" (41, page 112; Fig. 6). With high degrees of distention, the appearance of all levels becomes quite similar.

The position of the distended loop in the abdomen not only aids in differentiating small bowel from colon but also serves to differentiate between jejunum and ileum; loops of the former usually lie in the upper abdomen and to the left, while the latter is found more often in the lower mid abdomen.

Distention of the colon is easily recognized. The colon occupies a more or less fixed position around the periphery of the abdomen, so that when distended gut is

[2] It should be recognized that gas is always present in all portions of the intestinal tract. In some portions, however, it is so intimately mixed with the bowel contents that it is not recognizable on the roentgenogram. In the ensuing discussion the word *gas* will be used to denote that which is radiographically demonstrable.

[3] Throughout the discussion the term *intestinal obstruction* (commonly used synonyms are mechanical obstruction and dynamic ileus) will be used to indicate the presence of a mechanical occlusion of the bowel lumen. In all other cases, the term *reflex ileus* (commonly used synonyms are adynamic ileus, adynamic obstruction, and paralytic ileus) will be used. This term implies a disturbance in the normal physiology of the intestinal tract resulting in stasis of the intestinal contents, distention, and in some cases the collection of fluid, without obstruction of the bowel lumen. Reflex ileus may arise as the result of remote causes, such as disturbance of nervous control, or from actual pathologic changes in the bowel itself.

[4] The word *distention* will be used to indicate the presence of a more than normal amount of gas in any segment of bowel, large or small.

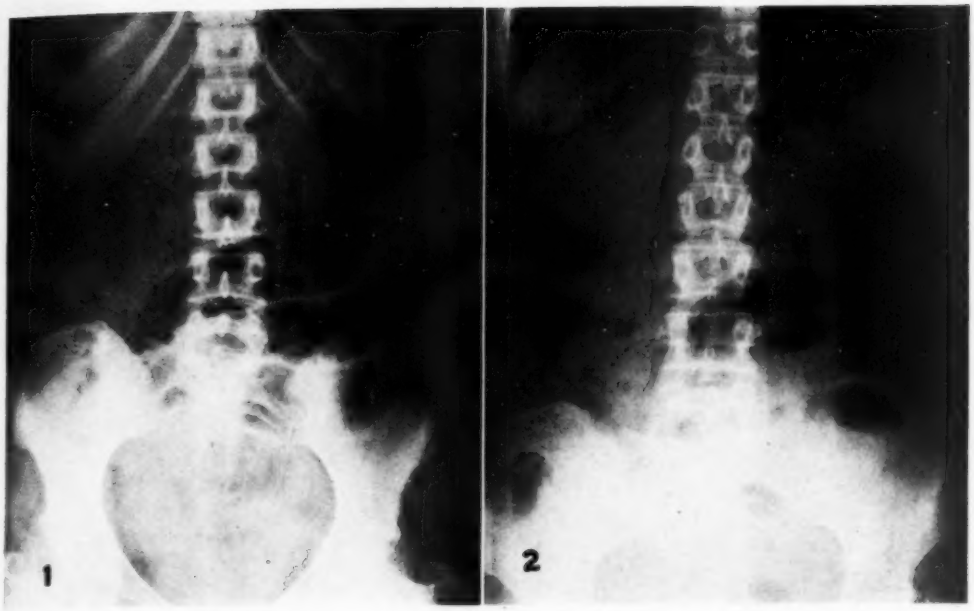

Fig. 1. The survey film demonstrates three gas-filled loops of small intestine lying one above another. This is the appearance in early cases. The appearance in an earlier stage is illustrated in Fig. 15. The latter is not a case of mechanical obstruction, but the roentgen appearance is indistinguishable from that noted in this case.

Fig. 2. The appearance of distended loops of small bowel in another early case of obstruction. This is similar to the preceding case (Fig. 1), but it is probable that more loops are distended, the increase in density between the gas-filled loops probably representing other loops which are filled with fluid.

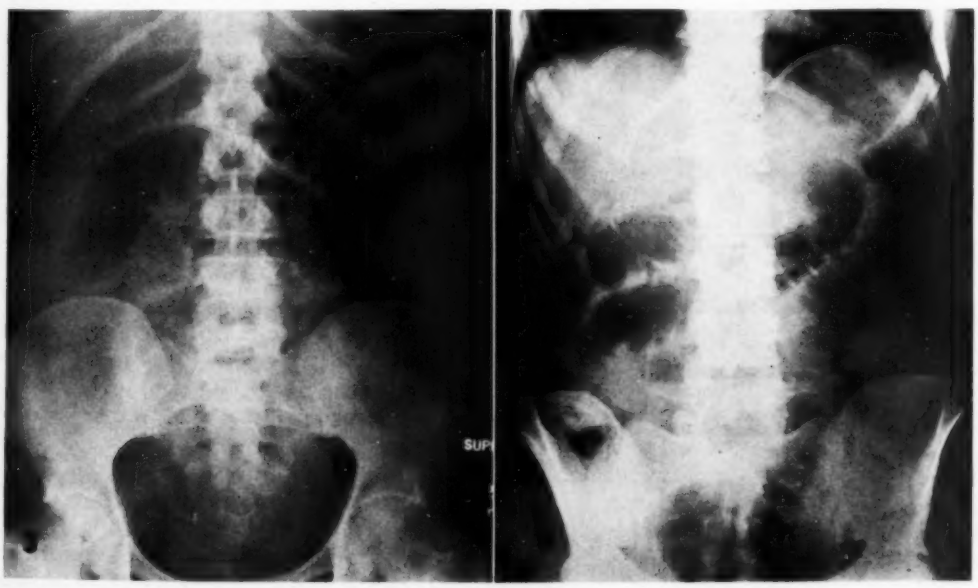

Fig. 3. In a moderately advanced small bowel obstruction more loops are distended and their caliber is in general increased, although the arrangement in the abdomen is much the same.

Fig. 4. A moderately advanced case of small intestinal obstruction, showing somewhat less regularity in the placement of the distended loops.

Fig. 5. The caliber and arrangement of the loops in a far advanced case of small intestinal obstruction are shown. The parallel arrangement still persists.

Fig. 6. The appearance of acutely distended small bowel after the administration of barium. (An error. Barium should never be given by mouth when bowel obstruction is suspected. Since the contents of the obstructed small bowel remain fluid, the presence of barium does not increase the degree of the obstruction, whereas in large bowel lesions, acute obstruction may be precipitated by the presence of drying masses of barium accumulating proximal to an incompletely obstructing lesion. However, the presence of barium may complicate the surgical procedure and hence is undesirable.)

Note the gradual disappearance of the intrinsic bowel markings from jejunum to ileum. The ileum is rather devoid of characteristic markings (the structureless character as described by Wangensteen). Such loops may easily be confused with sigmoid loops, and a barium enema is often necessary for positive differentiation.

Despite the acuteness of the obstruction, the lumen of the bowel was not completely occluded. A later film showed some barium in the colon.

seen occupying this position it is more easily identified as colon than are the more mobile loops of small bowel as jejunum or ileum. The haustral markings are usually visible—except in the lower descending colon and sigmoid, which, when distended, may very closely resemble loops of lower ileum—and are coarser and more widely spaced than the transverse lines of the upper small intestine. The presence of fecal material is also a great aid in identifying loops containing it as colon. The diameter of the distended colon is usually greater than that of a similarly distended loop of small intestine.

In the great majority of cases, obstruction of the colon is indicated by distention of the segments proximal to the site of the obstruction, with an absence of distention distally and with no small bowel distention. The collection of gas between the obstruction and a competent ileocecal valve produces a so-called "closed-loop" obstruction, and it is the roentgen picture of this distended loop which is characteristic of large intestinal obstruction. Under such circumstances, it is the cecum which is usually the site of the greatest distention, even though the obstruction may be in the descending colon or sigmoid. The danger of perforation of the cecum in this type of case, as pointed out by Wangensteen, is real (40; 41, page 153). The exact location of the obstruction is often evident, being marked by the point at which the distention is seen to disappear abruptly, and beyond which no air, or only a normal amount of air, is present. At times, however, the distention

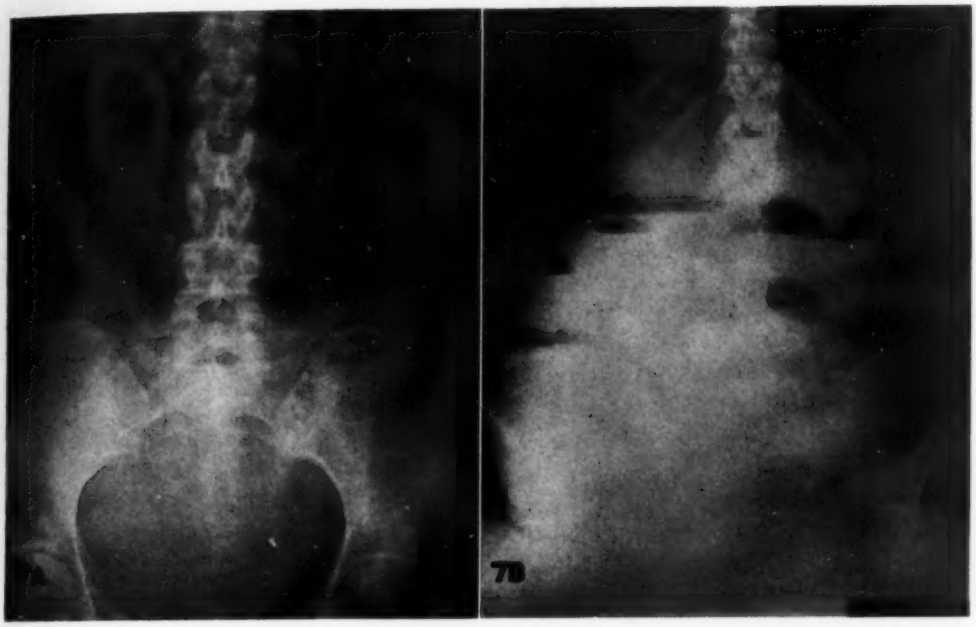

Fig. 7. The supine film (A) of the abdomen shows only equivocal evidence of intestinal distention. The erect film (B) shows fully the extent of the small intestinal distention, with multiple fluid levels. If the supine film alone had been made, the examination might have been interpreted as negative.

may appear to be limited to the right side of the colon, very little gas being present in the descending colon and sigmoid, and yet examination by barium enema will reveal an obstruction in the sigmoid. In view of this fact, distention of the cecum and ascending colon alone is suggestive, and the possibility of a low obstruction should be investigated by barium enema. It is noteworthy that this distention of the cecum may be noted even in cases which are not of the closed-loop variety; namely, in cases in which there is reflux of gas into the ileum through an incompetent ileocecal valve (Figs. 8 and 9). There is often considerable tenderness over a distended cecum, a circumstance which may lead to a suspicion of appendicitis rather than obstruction.

In occasional cases the distinction between the roentgen signs of small and large bowel obstruction is obscured by the location of the lesion—in the ileocecal region or just distal to the ileocecal valve—or by the presence of other than obstructive factors, commonly inflammatory.

Special circumstances apply to the diagnosis of obstruction in infants and children. The great majority of such cases are seen in infants and are congenital. The recognition of obstruction and its location is based on the absence of gas shadows in areas where they should normally be present.

The differential diagnosis between the manifestations of intestinal obstruction, as described above, and those of reflex disturbances producing intestinal distention is often difficult, and in many cases impossible, on the basis of the roentgen findings alone. In general, in cases of reflex distention, both the small and large bowel are involved, and the distention is less likely to be so uniform, with loops of both small and large intestine irregularly outlined and a conspicuous absence of a pattern suggesting continuity, which is the rule in organic obstruction (Fig. 10).

Reflex ileus occurs in the presence of pulmonary infections, cholecystitis and cholelithiasis, renal stones and renal infections, in infections of the intestinal tract itself, in

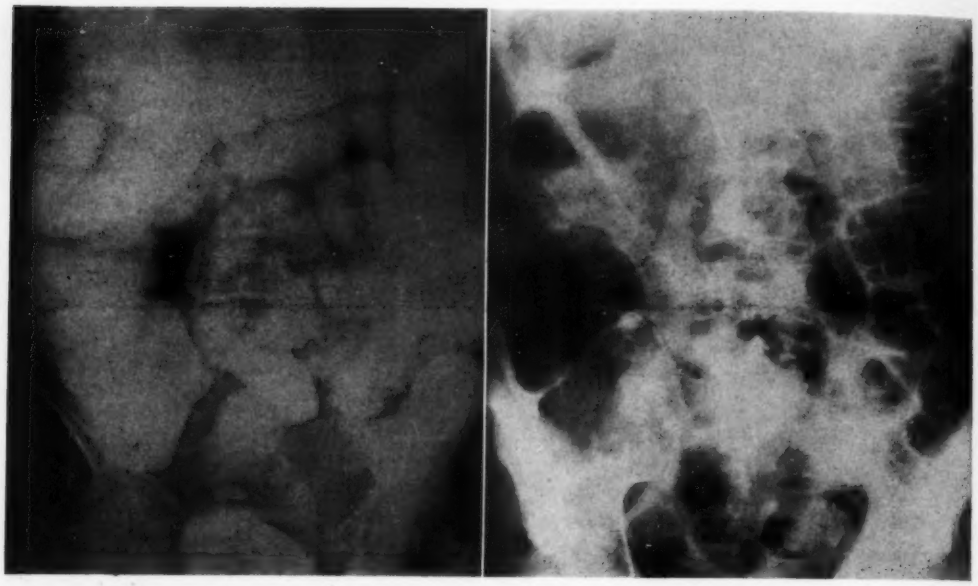

Fig. 8. Barium enema film showing a typical annular filling defect at the junction of the descending colon and sigmoid. This patient had had distention for several days and was vomiting. Note the extensive reflux distention of the small bowel. (In general, injection of barium into the colon should be carried out only to the extent necessary to demonstrate the lesion; larger amounts are unnecessary and may be deleterious.) Note the increased caliber of the cecum, even though there is small intestinal reflux.

Fig. 9. The survey film of the abdomen shows not only distention of the large bowel, but also extensive distention of the small bowel. At operation an obstructing carcinoma was found at the rectosigmoid junction. The distention of the small bowel was due to reflux through the ileocecal valve. Even with this "escape valve," note the high degree of distention of the cecum.

edema of the bowel (as in uremia and hypoproteinemia), and in embolism or thromboses of the bowel. Distention also accompanies peritoneal irritation, whether due to generalized acute peritonitis, chronic tuberculous peritonitis, or carcinomatosis. Retroperitoneal infections, *e.g.*, acute pancreatitis, and neoplasms, especially if involving the lymphatic structures, may also cause reflex ileus. Abdominal trauma and spinal cord lesions are common causes of ileus. The administration of drugs, especially morphine, may lead to distention. Conditions such as these should be looked for in any case of intestinal distention, particularly without typical intestinal colic, and in their presence a roentgen diagnosis of intestinal obstruction must be accepted with reservation until proved by barium enema or passage of the Miller-Abbott tube. Not infrequently a mechanical and a reflex ileus may coexist.

THE MILLER-ABBOTT TUBE

Advantages and Indications: The introduction of the double-lumen, balloon-tipped tube by Miller and Abbott (33) in 1934 marked a significant advance in the study of small intestinal physiology, and in the diagnosis and treatment of selected varieties of intestinal disease. The therapeutic use of the tube was first suggested by Abbott and Johnston (5) for relief of the distention of intestinal obstruction, with the thought that suction applied at or just proximal to the obstruction should be more effective than that applied at a distance (Wangensteen duodenal suction drainage). That their premise was correct has been shown by subsequent events.

At the same time Abbott (1) pointed out that the passage of the tube to a point of arrest would provide an accurate localization of the obstruction, particularly if a

barium solution were injected into the tube and roentgen studies were made.

Other advantages of the long tube soon became apparent. As the suction decompresses the bowel proximal to the obstruction, peristalsis returns (leading to further progression of the tube) and a normal segment of bowel is then available for the introduction of salt, fluids, and liquid nutriments. That portion of the nutrient fluid not absorbed may be removed. An intake and output record may be kept of the fluid given by mouth and that removed by drainage, and is a great aid in managing the electrolyte balance.

The opportunity to obviate the malicious effects of distention by decompression alone, without the hazard of surgical enterostomy, makes it possible for the surgeon to prepare the patient for operation over a longer period, and often converts an emergency into an elective procedure. The absence of a high degree of distention simplifies the surgical procedure. If the decompression is incomplete, as in cases of multiple obstructions, the tube may often be manipulated, at operation, past successive obstructions. With suction applied, each segment of obstructed gut may thus be decompressed without resort to direct aspiration. Following operation, the continued presence of the tube prevents distention and protects the suture line. Convalescence, therefore, is smooth, and complications, particularly new obstructions due to adhesions, are uncommon.

In general, the use of the Miller-Abbott tube is indicated in situations where the previously described advantages are desired. Distention, whether secondary to mechanical obstruction or of reflex origin, is relieved by decompression through the Miller-Abbott tube. In cases of mechanical obstruction the tube may be considered as a useful adjunct. It has proved in reflux ileus to be a therapeutic end in itself, since in such cases surgical enterostomy is generally conceded to be valueless, and sole reliance must be placed on non-surgical decompression. In such situations, the results have been truly brilliant.

Fig. 10. The usual appearance of a paralytic or reflex ileus, in this case postoperative. The distention is scattered irregularly throughout large and small bowel, and the loops of bowel are not greatly increased in diameter. Much greater distention may be present in more severe cases.

In surgical procedures involving resection of the large bowel, the prophylactic introduction of the tube has proved of value. The reefing of the small bowel on the tube decreases the volume of the abdominal contents, making operation easier (31). The presence of the tube after operation, as mentioned above, prevents distention, protects the suture line, and leads to a smooth convalescence (14). Ravdin and Abbott (36) report the use of the Miller-Abbott tube in 26 such cases with one death, thirty hours after operation, as a result of coronary occlusion. Whipple (44), in reporting his experience with resections of the large bowel, both right and left, during 1938–40, without the use of the Miller-Abbott tube, records a mortality of 18.4 per cent of 76 cases; while in a group of 36 similar cases in which the Miller-Abbott tube was used there was only one death, a mortality of 2.8 per cent.

Contraindications: There are few contraindications to the use of the Miller-Abbott

Fig. 11. Barium administered in error in a patient with atypical abdominal symptoms in whom the presence of obstruction was not anticipated. The obstruction was chronic and at operation was found to be due to scarring secondary to a chronic ulcer at the site of ectopic gastric mucosa. Note the difference in the intestinal markings as compared with Figure 6. This change is due to the chronicity of the obstruction. The entire bowel proximal to the obstruction was several times its normal thickness, and did not collapse when decompressed.

tube. It must not be used in persons known to have or suspected of having strangulation or gangrene of the bowel if operation is thus delayed. Its prophylactic advantages warrant its passage postoperatively, however. Since external hernias are readily approached, and since some contain strangulated loops, the use of the Miller-Abbott tube in such cases is contraindicated.[5] The tube should not be used in obstructions of the large bowel. In these cases there is an increase in tonus of the terminal ileum which makes uncertain and delays entry of the tip into the cecum, and the cecal contents are ordinarily too grumous for aspiration through the tube.

[5] Gatch and Montgomery (12) have recently described a method of treating strangulated external hernias which involves the use of the Miller-Abbott tube. The effectiveness of this method remains to be evaluated.

If there is reflux distention of the small bowel due to an incompetent ileocecal valve, decompression of the small bowel may be advantageous during the period in which the patient is being prepared for operation.

Complications: Few complications attend the use of the Miller-Abbott tube. Irritation of the upper respiratory passages may result, as from any indwelling nasal tube. Laryngeal damage has been reported in a number of instances (34; 42; 18; 22). Esophageal complications, particularly in patients with varices, have been recorded (19; 45; 16). Complications resulting from excessive coiling of the tube and from inability to deflate the balloon have been described (15; 37; 45; 20). In a case studied in this series (Case 9) a reverse intussusception was produced as the tube was withdrawn.

Technic: The successful use of the Miller-Abbott tube requires a detailed knowledge of the technic of its passage and care as established by past experience. The standard double-lumen tube arranged for suction distal to and proximal to a single balloon is most generally useful for routine diagnosis and therapy. This tube has an over-all diameter of 6 mm. (18F), with walls approximately 1 mm. in thickness. The lumina are unequal in size, the larger representing the suction side. The smaller lumen terminates just proximal to the metal tip and contains several small holes through which air may be injected into the balloon. The latter, made of thin rubber (condom or finger cot), is attached between the metal tip and the most distal suction aperture by means of silk thread. The proximal end of the tube is a metal Y-fitting; one side, marked "suction," connects with the suction side of the tube, the other, unmarked, with the balloon side. Modifications are available for purposes of special physiological investigation (7; 6; 2; 1; 21; 43; 3). The construction of a suitable tube using two tubes fastened together has also been described (2; 1; 35; 19). Johnston (19) favors the use of a No. 16 or 18F Jutte tube, which is stiffer than the Miller-

Abbott tube, to which is attached a small tube carrying the balloon.

The tube to be used should be in good condition. A tube which has become soft and limp as a result of improper cleansing and sterilization is difficult to manage. The tightness of all connections between tube and fittings and the patency of the lumina should be assured. A balloon of proper size should be attached. Too small a balloon will, when inflated, curl the tip of the tube; one which is too large will obstruct by overlapping the suction tip. The silk binding the ends of the balloon to the tube should not be tied so tightly as to obstruct the lumina. After attachment, the balloon should be inflated and tested under water for leaks, and the suction side should be retested for patency. The ability to deflate the balloon should then be tested.

After thorough lubrication of the tip (and preliminary local anesthesia of the nasopharynx if desired, although this is rarely necessary), the tube may be passed through the larger nostril, into the esophagus, and thence into the stomach.

We prefer, at this point, to remove the patient to a fluoroscopic table. (If any delay in preparations for passage of the tube is anticipated, the patient may, if desired, be placed on the fluoroscopic table as soon as the decision to intubate is reached. Administration of fluids by venoclysis or hypodermoclysis may then be instituted and may be continued without interruption until passage of the tube is completed.) With the patient comfortably arranged on the table, the suction drainage apparatus should be connected to the suction side of the tube and suction started. At this point, if not previously arranged, fluid administration may be begun. When the stomach has been emptied, passage of the tube through the pylorus may be attempted. While it is not always possible, especially in obstructions of some duration, to deflate the stomach completely (apparently because of continued reflux from below), this should be attempted. It is much easier to manipulate the tube through the pylorus of a collapsed stomach than through that of a distended stomach.

Under fluoroscopic guidance, the tube should be withdrawn until the tip is at the cardiac orifice (unless the position of the tube, with the tip in the pyloric antrum, is already satisfactory). The patient is then placed on his right side and the tube is advanced. With the patient in this position, the pylorus is dependent, and gravity will carry the tip of the tube into the pyloric region. An attempt should then be made to pass the tube slowly, inch by inch, directly through the pylorus, under fluoroscopic guidance. In many cases the tube may be seen to enter the duodenum and traverse the duodenal curve. If the tube will not pass, a few inches of slack should be left in the stomach, care being taken that the introduction of this additional amount does not curl the tip upward in the stomach and away from the pylorus, and the patient should be allowed to rest, still lying on the right side. During this time suction should be maintained.

If, after one-half to three-quarters of an hour, no progress has been made, suction should be discontinued and the patient allowed to drink a glass of warm water, which may stimulate peristalsis enough to carry the tip through the pylorus. (Instead of water, something for which the patient has an appetite may act as a more effective stimulant to peristalsis. A case has been reported in which, after a glass of beer, which the patient had been craving for days, the tube passed rapidly.)

If the tube still fails to pass, suction should be re-established and the patient allowed another rest period, still lying on the right side. At the end of this period a further attempt at passage through the pylorus should be made. (Occasionally other positions, such as the prone or erect, may be more favorable, and should be tried.) If this fails, further time must be allowed, during which the tube may pass; or, if the situation is such that urgent passage is required, the tube should be removed, fitted with a stylet, and reintroduced. (Abbott advises attempting to

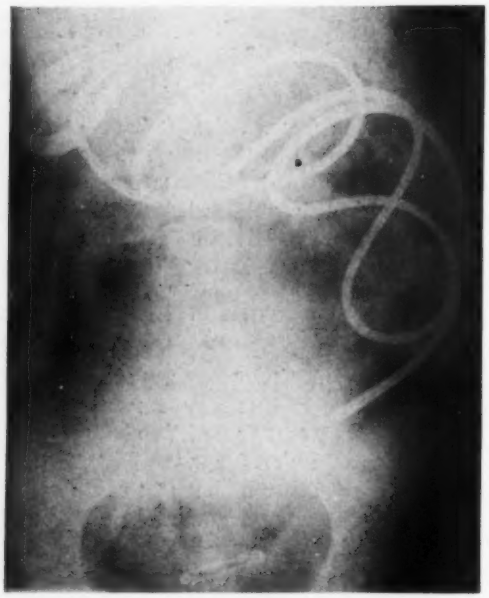

Fig. 12. Two loops of tube have prolapsed through the pylorus. Too much tube should not be passed into the stomach.

pass the tube first without the stylet, since the latter's effectiveness depends, to a great extent, on previous decompression of the stomach. If, however, previous gastric suction has been used, one might well take advantage of the opportunity to use the stylet immediately.)

Abbott (4) has described the use of a wire stylet to stiffen the tube. His directions for its use are as follows:

"Pierce the wall of the aspirating lumen of the tube at the 50 cm. (2 feet) mark with a length of 0.4 mm. (0.106 inch) diameter, specially straightened, stainless steel vom Hofe leader wire, and advance the tip of the wire to a point 2.5 cm. (1 inch) above the most proximal aspirating hole in the tube. Bend a loop in the other end of the wire so that tip cannot advance distally. The terminal 15 cm. (6 inches) of tube will then contain no wire. Pass the tube in the usual manner. With a temporary adhesive tape patch over the point at which the stylette pierces the tube wall, inject 300 c.c. of air into the stomach and advance the tube until it lies along the greater curvature. Hold the tube at the patient's nose to prevent its slipping out, and apply suction to remove the air. The stomach contracts, squeezing the tip of the tube ahead. The antral spasm, with concentric contraction, prevents the terminal 15 cm. from coiling and the stylette prevents coiling of the tube proximal to the antrum, where the stomach is more flaccid. Draw back the tip of the stylette from the pylorus and, by steady gentle pressure on the tube at the nose, advance the tip into the duodenum. Withdraw the stylette, and patch hole with thin rubber."

Unless the stomach is well collapsed, 2 feet of wire will often be found insufficient to reach the antrum. Hence it is wise to consider introducing the stylet 4 rather than 2 feet above the tip. In fact, if it is desired to avoid puncturing a hole in the active portion of the tube (patching is not always satisfactory), the wire may be introduced at the extreme proximal end. Presumably the use of an L- instead of a Y-fitting, with the long arm of the L continuous with the suction side, would enable one to introduce the stylet the full length of the tube, with no puncturing of the walls necessary.

It is possible, furthermore, by the use of a longer stylet to extend the tip of the wire past the suction holes until it rests in the region of the balloon; or it may be passed along until the tip of the wire rests within the metal tip itself. If this technic is to be attempted, it is wise to slightly enlarge and blunt the end of the stylet by soldering, so that any accidental protrusion through the suction holes, or through the tube itself, would be less likely to damage the bowel wall. The increased stiffness of the tube makes considerable care necessary in introducing it through the nose and pharynx, but passage can be attained without undue trauma.

With the stylet extending to the tip of the tube, passage through the pylorus is sometimes attained with greater speed and facility than with any other method. If this method is used, the stylet is allowed to remain in place until the balloon has passed into the duodenum. The balloon is then inflated and, under constant fluoroscopic guidance, the stylet is removed. If the stylet cannot be withdrawn easily—it usually can be, particularly if it and the suction side of the tube have been lubricated previously with a thin mineral oil—the tube may have to be withdrawn into

the stomach and the stylet removed. In such cases, with the exact direction of the pylorus having been located, the tube can usually be repassed into the duodenum without the stylet. It is considered unwise to allow the tube to progress into the small intestine with the stylet in place (this could be possible only in instances in which the wire had been passed the entire length of the tube).

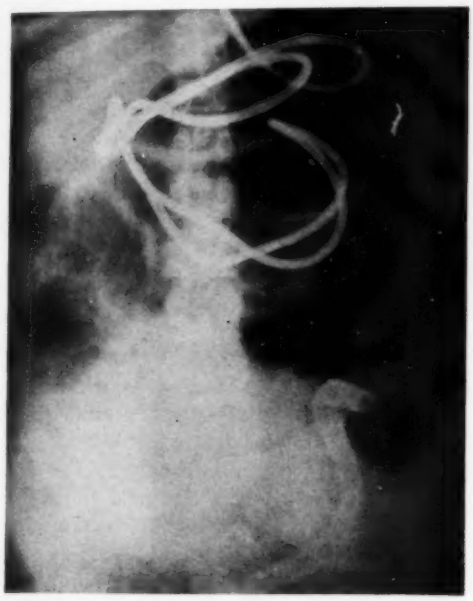

Fig. 13. Prolapse of a loop of tube through the pylorus, through which the tip of the tube has already passed.

After the balloon has reached the descending duodenum, 20 c.c. of air are injected into the balloon side of the tube. As the air is injected, the balloon should be observed fluoroscopically to make sure that it inflates. If the tip of the tube does not progress as the balloon is inflated, but regurgitates, the air should be withdrawn immediately and the tube be passed farther along the duodenum before the balloon is again inflated. More than 20 c.c. of air are unnecessary and possibly dangerous.

When the balloon has been inflated, the tubing leading from the balloon side is clamped with a hemostat and the handle of the latter bound with adhesive tape so that

Fig. 14. Film showing an entire Miller-Abbott tube in the stomach. A knot was present, which made it difficult to withdraw the excess. In the supine position, only a foot or so could be withdrawn. At this point the knot and an entangled loop were drawn into the esophagus. In the prone position, the loops disengaged themselves to the extent that all the excess down to the knot, which was about 8 inches proximal to the tip of the tube, could be removed. A slight excess of tube was left in the stomach overnight. Peristaltic activity untied the knot.

it cannot slip or be removed accidentally. It is well to mark the adhesive: "Do not remove."

The patient may then be removed to bed, where the suction is re-established and fluid administration is resumed, if it has been discontinued during transfer from fluoroscopic table to bed.

The great difficulty sometimes experienced in getting the tube through the pylorus has led, in some quarters, to a lack of confidence in the usefulness of the tube. Much of the delay in the past has been due to failure to use frequent fluoroscopic or radiographic check-ups. If the tip of the tube is presumed to be at the pylorus, but actually is not, no amount of waiting will accomplish its passage. As more and more tube is introduced, loops form in the stomach, one of which may pass through the pylorus (Figs. 12 and 13), or the tube

may even become knotted (Fig. 14). In the latter event, Abbott has shown that provision of plenty of slack will enable the activity of the stomach to untie the knot. If the tip of the tube is believed to be in the duodenum, but actually is not, and the balloon is fully inflated, passage will certainly not be achieved. Abbott (1) originally described a syringe method of determining whether the tip had passed through the pylorus, but this test has not always been dependable (20).

Many other suggestions to aid in getting the tube through the pylorus have been offered, most of which have not enjoyed a very wide usefulness (32; 9; 38; 8; 41, page 156; 27).

The use of mercury in the balloon of the Miller-Abbott tube (41, page 164; 13) has been widely adopted and has been so effective that it has replaced, to a great extent, the use of the wire stylet. My own experience with this method has been quite satisfactory. Two or 3 c.c. of metallic mercury are injected into the balloon (this amount is as effective as the larger amounts originally recommended by Harris). The patient is then turned on the right side and in favorable cases gravity will promptly carry the tip of the tube into the duodenum. Although Harris states that in most instances the tube will progress well without air in the balloon, in my experience passage has been more rapid when air was injected into the balloon as usual. Since mercury is chemically inert, no harmful effects are to be expected if the mercury should escape into the intestinal tract.[6] The tube is removed as usual with the mercury still in the balloon.

[6]Mercury should not be used in the lumen of the Miller-Abbott tube with the assumption that, if the balloon should break and mercury escape into the intestinal tract, no harmful effects would occur. While no reports of such a harmful result have as yet been published, proof of the lack of toxicity under these conditions has not been established. Leon Lewis (personal communication), who has had considerable experience with the toxicology of metallic mercury, says: "The sort of emulsion which might form in the intestinal tract if the metal could not readily escape, would, I am sure, render it absorbable and toxic." Miller (personal communication), on the basis of the literature on the toxicity of mercury, feels that its escape into the intestinal tract is a definite hazard and advises against its use.

Most important of all to success in the use of the tube are experience, persistence, patience, and the use of fluoroscopic control. In the earlier work with the Miller-Abbott tube, many were reluctant to subject the patient to a number of hours on a fluoroscopic table, but as experience was gained, it became apparent that the hours lost while the tube was unknowingly curled in the fundus were more dangerous. (The use of fluoroscopic guidance warrants a word of caution, especially if many observations have to be made. Each period of exposure should be only as long as necessary, and adequate precautions should be taken to protect both patient and fluoroscopist from excessive exposure. If the fluoroscopic examinations are made by one accustomed to the use of x-ray equipment, preferably the radiologist, the technic may be so planned that any patient may have all the examinations necessary without danger of over-exposure.)

The value of experience is demonstrated by the success of Abbott, who personally passed most of the tubes used in the University of Pennsylvania Hospital, and of Johnston (19), who worked with Dr. Abbott in the early years and in whose clinic in subsequent years 500 intubations were attempted with only 6 failures. Comparable results have doubtless been obtained elsewhere by those with special experience and organization. Close supervision over and personal responsibility for the passage of the Miller-Abbott tube are important if success is to be attained. Bennett (8) says:

> "An individual who is familiar with the various methods of intubation must take the full responsibility and must be prepared to spend the time necessary for the procedure and for close observation of the patient. Too often the surgeon, who may be familiar with the principles but not the practice of intubation, is satisfied with the half-hearted, inefficient attempts of the inexperienced members of the house staff.... Inexperience predicts a high percentage of failures, invites complications, and is responsible for the disregard which some physicians hold for intubation."

The successful progress of the tube through the small intestine depends on the

maintenance of adequate suction and on continued inflation of the balloon. The correct operation of the suction apparatus must be checked frequently, and the suction side of the tube irrigated frequently in order to make sure of its patency. An accurate record should be kept of the amount of drainage, since this represents fluid lost to the patient which must be replaced, together with the chlorides contained therein. If replacement fluids are administered orally, these should be given with the necessary amount of salt. Foods given orally should be those which will leave only such residue as can be removed by suction if necessary and which cannot block the tube.

The balloon should be tested frequently for leaks by comparing the amount of air which can be withdrawn with the amount injected when the balloon was last inflated. Care should be taken that no more than 20 c.c. of air are injected, and that the nursing staff, while caring for the suction apparatus, does not in error deflate the balloon by loosening or removing the clamp on the balloon side. Occasionally, confusing the two sides, the nursing staff may clamp the suction side and attach the suction apparatus to the balloon, or even inject fluid into it. It is preferable to assign to the care of these patients a nurse who has been specially trained for this work.

During the period that the tube is progressing, the patient should be made as comfortable as possible. Special attention should be paid to mouth hygiene and to relief of the irritation of the nasopharynx. It is best, however, not to use mineral oil for the latter purpose, as suggested by some, because of the possibility of aspiration and subsequent lipoid pneumonia. The tube should be fastened to the cheek or forehead by a cloth tape (10) or a Montgomery type strap with rubber bands (17), as adhesive sticks to the rubber and makes further passage of the tube through the nose disagreeable.

If there is any doubt as to the ability or willingness of the patient to co-operate, and he cannot be watched *constantly*, restraints should be applied in such a way as to make it impossible for him to remove the tube. Such an accident not only requires repetition of perhaps hours of work, but may result in disaster if the tube is forcibly withdrawn with the balloon inflated.

The exact length of tubing which should be passed into the stomach during any period is difficult to determine except by frequent x-ray and fluoroscopic observation. In general, the tube should be passed into the stomach at approximately the same rate as it is leaving the stomach, so that not enough accumulates to prolapse or knot. The tube should not be fastened to the cheek unless a slight excess is present in the stomach, otherwise excessive reefing of intestine on the tube may occur.

In cases of simple mechanical obstruction, the tip of the tube usually moves quite rapidly down the small intestine and may be in the terminal ileum, if the obstruction is not higher, in twelve to thirty-six hours or even less. In cases of reflex or paralytic ileus, however, the progress of the tube is much slower, several days being required for the tip to reach the cecum. In Leigh's experience (24), 2.1 days were required for the tube to traverse the length of the small bowel in cases of ileus due to operative trauma, while in cases with edema of the bowel, 6.2 days were required. In the latter group, progress became more rapid with the disappearance of the edema as a result of diuresis or otherwise. Since the small intestine, as it is decompressed and the tube is passed down, characteristically reefs itself upon the tube, the full length of the tube may not be required. Frequent fluoroscopic or radiographic checks are necessary to make sure that there is not enough slack in the stomach to allow knotting or prolapse of an extra loop through the pylorus, either of which will stop the progress of the tube. The success of the decompression and the progress of the tip are also followed. It is important that roentgen checks be made not more infrequently than once every twenty-four hours so that, if the tube becomes arrested, a barium injection can be done to deter-

mine whether or not the point of obstruction has been reached.

Some care should be exercised in removing the tube. This should be done slowly, over a period of several hours, after deflation of the balloon. It is wise to check the position of the tube, the possible presence of knots, and successful deflation of the balloon fluoroscopically before removal. If at any time during its withdrawal difficulty is encountered, a further check should be made before continuing.

Barium Injection: The investigation by the injection of barium of cases of small intestinal obstruction in which the Miller-Abbott tube has been passed is not difficult. The injection studies are made at a time when the interval survey examinations have shown that the tip of the tube is no longer advancing. If the tip of the tube is arrested at the point of the obstruction, and there are no extraneous factors present, there should be at this time no intestinal distention. If distention is still present, and the suction is known to have been effective during the hours previous to the examination, then the tip of the tube has not yet reached the obstructed point (failure to progress may be due to reflex disturbance, deflation of balloon, etc.), the tip of the tube has reached one point of obstruction with one or more other obstructions lying distal to it, or the distention may be due to complicating factors, such as generalized peritonitis. The injection of barium, by showing whether or not obstruction is present, makes the evaluation of the findings much easier, as well as showing the location, and possibly the nature, of the obstruction if present. The value of this procedure in distinguishing between mechanical obstructions and reflex distention is indicated by Leigh and Diefendorf (25), who apparently have found the differentiation so difficult without it that they define paralytic obstructions as those in which mechanical obstructions are not demonstrated by intubation.

A suspension of one part of barium sulfate in four parts of water has been found satisfactory. While the shadow is not dense, particularly if further dilution occurs as a result of the presence of fluid within the injected segment, a thicker solution is difficult to withdraw, and it is most important not to impair the usefulness of the tube by blocking it with a suspension so thick that it cannot easily be removed on completion of the examination. While the solution is being prepared, a survey film of the abdomen should be made for later orientation.

The barium suspension is injected into the suction side of the tube by attaching a syringe directly to the metal attachment. Sixty to 100 c.c. of suspension will usually suffice. If the injection is made with the balloon still inflated, fluoroscopy will show most of the barium collected in the segment proximal to the balloon. When the balloon is deflated, the barium will then pass by, although not always quickly, and not always without changing the patient's position. It should be remembered that a considerable part of the small intestine proximal to a point of obstruction is reefed upon the tube, so that when the balloon is deflated a variable amount will slip forward. As a result, the tip of the tube may change its position in the abdomen, and the point of obstruction will, in many cases, subsequently be found to be some distance from the tip.

Fluoroscopic observations are made with the aid of palpation and change in the patient's position as necessary to cause the barium to advance and to demonstrate the morphologic details to best advantage. Spot films are made as indicated. The configuration of the barium column varies in accordance with the conditions present. In some cases barium will be seen to advance only as the patient is rotated. This usually indicates the presence of a kink, such as occurs in many instances of adhesive obstruction. Sometimes barium will be seen to advance intermittently, its flow past the obstruction coinciding with a visible increase in the peristaltic activity and the occurrence of typical intestinal colic. In this type of case, while the obstruction is clinically complete, in that cessation of

suction or removal of the tube will result in immediate recurrence of intestinal colic, the fluoroscopic examination indicates that actually the lumen is not entirely occluded to fluids under the pressure of increased peristaltic waves. The incompleteness of the obstruction as observed under the above conditions has been previously noted by Leigh, Nelson and Swenson (26) and Abbott (1). Abbott (4) felt that as a distended bowel was decompressed there was an increase in its blood supply, with a consequent lessening of irritability and spasm and a return of peristalsis. It was to these factors that he attributed the fact that injection of barium after decompression often demonstrated an incomplete obstruction of the bowel lumen. It would seem, however, that the demonstration, in such a case, at the time of the injection, of fighting peristalsis accompanied by intestinal colic (and also immediate recurrence of distention if suction is discontinued) would indicate rather that the clinical signs and symptoms of acute obstruction may occur despite the fact that the bowel lumen is not entirely occluded. Further evidence in support of this thesis is noted in the occasional case in which, in error, a mouth meal is administered. While barium collects in the distended fluid-filled loops, films made at intervals do show some barium to have passed the point of obstruction.

In some cases, while barium is seen to pass a point of incomplete obstruction, distention of the loop immediately proximal to it will persist. This situation is usually encountered in cases in which the obstruction is of long standing, and at operation the wall of the bowel is found to be thickened and the lumen permanently widened (Fig. 11).

The segment of bowel beyond the point of obstruction should be of normal caliber. If it is not, and particularly if fluid and gas are present, the possibility of a more distal obstruction should be considered. Under these circumstances, observations by films or fluoroscopy should be continued until the barium has had a chance to reach such an obstruction. If the distance is great, however, it is likely that the barium will be so diluted as to lose its diagnostic value.

If no barium is seen to pass the point of obstruction at the first observation, further observations should be made at intervals. During this time, the suction apparatus should be disconnected, to test the patient's tolerance to the discontinuance of suction. When the examination has been completed, the barium which remains proximal to the obstruction should be removed by irrigation and suction.

The value of the barium injection lies primarily in the determination of the presence or absence of obstruction. In the exact determination of the nature of the obstruction the examination is not so valuable, although in many cases the demonstration of an incomplete obstruction with sharp angulation of the bowel at the point of occlusion is suggestive of adhesions. The nature of obstructions due to other causes is not always revealed.

The demonstration of the anatomical degree of obstruction does not always determine whether or not eventual operation will be required. Complete obstructions may not require operation if, during the course of continued decompression, the etiologic factors disappear, as may frequently occur. Obstructions demonstrated by intubation and injection to be incomplete may, on the other hand, be persistent and require operation, since discontinuance of decompression, even for a few hours, may lead to prompt recurrence of intestinal colic and distention.

Evaluation of Usefulness: The past forty years have witnessed a significant drop in the mortality rate for patients with intestinal obstruction. Many factors have contributed to this decline. The earlier recognition of the presence of obstruction, due in great part to more frequent roentgen examination and greater experience with, and reliance on, the roentgen findings, has in many cases made the immediate operation a truly early one in so far as the duration of the obstruction is concerned. There is no disagreement with the belief that early

operation, if it could be carried out in every case, would be the greatest single factor in a successful outcome. McKittrick and Sarris (30), for example, had no deaths in 42 patients with acute mechanical obstruction of the small bowel operated upon within twenty-four hours of the onset of symptoms; while in 17 patients admitted within twenty-four hours of the onset of symptoms but not submitted to emergency operation the mortality was 29 per cent.

Improvements in operative technic have undoubtedly played a part in the reduction of mortality, but probably more important than this has been the improvement in the non-operative adjuncts to therapy which were instituted following the introduction of the newer concepts of the pathologic physiology. First among these was the appreciation of the necessity for correcting an abnormal fluid balance and maintaining a normal balance until such time as operation could be carried out and convalescence established. Later, the malicious effects of distention alone were recognized, and methods for intestinal suction developed. The correction of fluid balance and the relief of distention have enabled the surgeon to treat more successfully the case which, when first seen, is already beyond the stage when operation, no matter how immediate, could be considered early.

In selected cases the use of sulfonamides at the time of operation and postoperatively has also contributed to a decreasing mortality. The applicability of penicillin is now being studied.

While the value of the above factors is evidenced in a declining mortality rate, the degree to which each is responsible for the decline is obviously difficult to evaluate statistically. This is particularly so for the use of intestinal suction, and for any assessment of the value of the Miller-Abbott tube as compared with the simpler and older method of duodenal suction.

Statistics in the recent literature and from the Peter Bent Brigham Hospital were evaluated in 1942 by Blodgett (11). His study concerned simple mechanical obstructions of the large and small bowel. In a group of 306 cases without complicating peritonitis in which suction was not used (suction implied actual presence of the suction tube in the jejunum) the mortality was 17.3 per cent, while in 151 cases in which suction was used the mortality was 7.9 per cent. In a group of cases complicated by peritonitis, there was a mortality of 73.1 per cent in 56 cases in which intestinal suction was not used, and a 25 per cent mortality in 52 similar cases treated by suction. These differences were calculated by Blodgett to be statistically significant.

Leigh and Diefendorf (25) treated 132 cases of non-inflammatory mechanical obstructions of the small bowel by surgery and the Miller-Abbott tube, performing 103 operations in this group. The mortality was 4.6 per cent. In a similar group of 94 cases complicated by peritonitis there were 70 cases in which the Miller-Abbott tube was passed into the small bowel, with a mortality of 15.7 per cent, and 24 cases in which the tube was not used or did not pass into the small bowel, with a mortality of 32.5 per cent.

Whipple (45) treated 311 cases of acute ileus (presumably including paralytic obstructions and those with peritonitis) by surgery and the Miller-Abbott tube, with a gross mortality of 13.5 per cent. In 248 cases successfully intubated, the mortality was 9.7 per cent, while in 33 cases in which the tube failed to pass, the mortality was 54 per cent.

McCleery (28) reported 101 cases of simple mechanical obstruction of the small bowel treated between 1935 and 1940, without reference to the use of suction drainage. There was a mortality of 21 per cent in this group.

McKittrick and Sarris (30) in 1940 reported a group of 136 cases of acute mechanical small bowel obstructions, 33 per cent of which were strangulated. The gross mortality was 20 per cent. The mortality of the non-strangulated cases was 3 per cent. The mechanical factor of distention at operation was said to be a factor in 30 per cent of the deaths in the

series. No statistical data are given in reference to the use of the Miller-Abbott tube in these cases. In 1941 McKittrick (29) reported 18 cases of simple small intestinal obstruction with no deaths. "In two patients, both over 60 years of age, decompression by means of the Miller-Abbott tube was life-saving. From a review of these cases it is quite likely that had early operation been instituted, death would probably have resulted in each case."

An analysis of cases of small intestinal obstruction seen in the Hospital of the University of Pennsylvania follows.[7]

UNIVERSITY OF PENNSYLVANIA CASES, 1939–43

Small Intestinal Obstruction, Non-Strangulated, No External Herniae, No Generalized Peritonitis

Total obstructions	53
Total patients	49
Age	
Under 25	5
25 to 50	24
Over 50	20
Sex	
Male	18
Female	31
Duration before admission	
One day	6
One to five days	13
Over five days (including those with indefinite histories and chronic cases)	34
Total cases using Miller-Abbott tube	34
Successfully	29
Unsuccessfully	5
Hours required for Miller-Abbott tube to pass into duodenum	
Less than twenty-four	25
Twenty-four to forty-eight	2
Forty-eight to sixty	2
Would not pass	3
Would not pass through gastro-enterostomy	2
Hours for Miller-Abbott tube to pass to site of obstruction	1 to 4 days
Day of operation after Miller-Abbott tube passed	1 to 7
Days Miller-Abbott tube in, in non-operated cases	1 to 5
Days Miller-Abbott tube in after operation	2 to 6
Location of obstructions	
Duodenum	1
Jejunum	6
Ileum	35
Multiple or undetermined	11
Degree of obstruction	
Complete	28
Partial	25
Etiology of obstruction	
Kinking or constriction due to adhesions	35
Jejunal ulcer with stenosis	1
Peritoneal carcinoma	6
Internal hernia	2
One herniation of gastrojejunostomy through gastrocolic omentum; one herniation through hole in mesosigmoid	
Appendix	2
One abscess with adhesions; one case of postoperative adhesions (perforated appendix)	
Gallstone ileus	1
Carcinoma of pancreas	1
Tumor	3
One intussuscepting myxoangioma; one intussuscepting leiomyoma; one adenocarcinoma of ileum	
Regional ileitis with abscess and adhesions	1
Operations	
Lysis of adhesions	25
Ileocolostomy	2
Resection of small intestine	5
Enteroenterostomy	2
Gastrojejunostomy	2
Ileostomy	4
Release of internal herniae	2
Jejunojejunostomy	1
Removal of gallstone	1
Exploratory only	4
Cases not operated (all adhesions)	
Miller-Abbott tube used	4
Miller-Abbott tube not used	1
Deaths in hospital	5
Four patients had peritoneal carcinomatosis; one died of pulmonary complications but with obstruction relieved	
One patient had regional ileitis with multiple localized abscesses and fistulae	
Deaths outside of hospital	2
Obstruction unrelieved by hospital treatment. Both had peritoneal carcinomatosis	
Gross mortality	
By patients	14.3%
By cases	13.2%

[7] Thanks are due Drs. E. E. Eliason and I. S. Ravdin for permission to study the records of patients treated on their services.

Corrected mortality	0.0%
Excluding all deaths, since in each instance the obstruction was only an incident in an otherwise irremediable disease	
Roentgen diagnosis	
Survey films	30
Positive diagnosis (all correct)	20
Negative diagnosis (all incorrect)	5
Inconclusive	5
Gastro-intestinal series (all correct)	4
Injections of Miller-Abbott tube (all correct)	16
Complete obstruction demonstrated 3 times; incomplete 13 times	

PHILOSOPHY

It is apparent that the patient with intestinal obstruction has a much greater chance of survival today than even a decade ago. The mortality, however, is generally high, except in selected centers where special interest is taken in these cases and special organizations have been developed for their treatment. Under such circumstances, many patients in the advanced stages of obstruction may be cured, and the superiority of results in such centers is probably largely accounted for by this group. There is no doubt, however, that wherever medicine is practised good results may be expected without extraordinary skill or special equipment, provided an early diagnosis can be made and treatment instituted promptly thereafter. All series of statistics show that, regardless of fluid administration, blood transfusions, duodenal or Miller-Abbott intubation, or other procedures, the mortality is lowest in that group of patients operated upon within a few hours after the onset of symptoms, and a successful outcome may be anticipated in this group even though none of the non-surgical adjuncts is employed. It is possible, therefore, for the surgeon who sees such cases only infrequently to secure as good results as his colleague for whom intestinal obstruction holds a special interest, provided only that the patient is referred to him early.

The responsibility devolves upon the physician first consulted, be he general practitioner, internist, or gynecologist, to consider whether or not his patient may have intestinal obstruction and to take appropriate steps to establish the diagnosis. It is at this point that the radiologist has his greatest opportunity to contribute to a successful outcome. The radiologist who has the proper clinical background may consider, with the referring physician, the symptoms and physical findings which are so necessary to the interpretation of the x-ray examination which is to follow.

In so far as the latter is concerned, an attempt has been made to emphasize the roentgen findings which may indicate obstruction in its earliest stages. While it is true that multiple distended loops of small intestine containing fluid levels often point to obstruction, this appearance is not in itself diagnostic and is certainly not indicative of the early stage at which diagnosis is optimally established. Furthermore, cases have been cited which show that such findings may not indicate obstruction at all, at least in the sense of mechanical blockage of the intestinal lumen. The importance of the latter concept lies in the fact that exactly the wrong method of treatment—intestinal intubation—may be elected on the basis of a mistaken diagnosis, delaying operation, which should be done immediately. Such errors may usually be avoided if overconfident reliance is not placed upon the roentgen findings to the exclusion of the clinical observations and laboratory data. It is evident, therefore, that, despite the importance of the roentgen examination, an exactly correct objective diagnosis may not be given in all cases. Furthermore, under such conditions the radiologist, unless he is an astute clinician and in possession of all the facts, cannot take it upon himself to do more than confer with the surgeon as to the type of treatment to be elected. The latter responsibility must fall upon the surgeon.

Provided intestinal intubation is decided upon as a preoperative therapeutic adjunct, or, in cases involving the colon, for its postoperative effect, the radiologist

is in a position to participate in the actual treatment of the patient. An attempt has been made to point out the value of radiologic procedures in the passage of the tube, and for study of the intestinal tract after the tube is in place, and to describe those procedures in some detail in the hope that the radiologist, becoming more familiar with them, will be better able to participate.

The part the radiologist may play will vary from simple fluoroscopy to more or less complete responsibility for the passage of the tube and its care. In highly organized clinics where special personnel is available, a system of division of labor and responsibility will probably prevail, but good organization, whatever its nature, will lead to good results. Successful use of the Miller-Abbott tube, as indicated above, requires that definite responsibility for its use must be accepted somewhere along the line, and it is our opinion that under many circumstances the radiologist may well volunteer to accept this responsibility. His possession of the necessary fluoroscopic and radiographic equipment, his more or less constant presence in the hospital, and the probable availability of time make it logical for him to do so. We feel that by so doing the radiologist has a great opportunity to perform an important service to the surgeon and his patient. We are convinced that under such a system, the patient may benefit from the use of a procedure which might otherwise be neglected or even fall into complete disrepute.

Diagnostic procedures performed by injection of barium through the Miller-Abbott tube have been described. Our experience has not established their indispensability, however. While the studies have demonstrated, again, the physical incompleteness of many small intestinal obstructions, they have not indicated to any significant extent the necessity for operation. In this respect the clinical observations as to whether or not there is a recurrence of intestinal colic and distention after discontinuance of suction have been more important.

CASE REPORTS

CASE 1: A. B., a 30-year-old white male, had been operated on several times in another city, a resection of the bowel having been performed in stages. Following these operations, the patient had enjoyed good health until 8 P.M. on the evening of admission, when he was seized with sudden severe abdominal pain, colicky in character. He was admitted to the hospital four hours after the onset of symptoms, at which time he was suffering from intermittent crampy pains, accompanied by hyperactive peristaltic rushes. No distention was evident clinically. A survey examination of the abdomen showed a distended loop of small intestine, "hairpin" in character, on the left side of the abdomen. The erect film showed no fluid level. A diagnosis of intestinal obstruction was made, and immediate operation was performed. The abdominal incision was made directly over the region occupied by the distended loop. A short segment of distended gut was found proximal to an annular constriction. A resection and anastomosis were done and the patient recovered without incident. The constricting lesion was pathologically an adenocarcinoma.

This case demonstrates the rapidity with which a roentgenologically demonstrable degree of distention may develop (four hours after the onset of symptoms), the value of the distended loop in locating the abdominal incision, and the importance of immediate operation.

CASE 2 (Fig. 15): W. B., a 42-year-old colored male, was admitted to the hospital at 7 P.M. on Jan. 9, 1941. Three hours earlier he had been injured by a falling board, which knocked him to the ground and struck him across the abdomen. On admission his temperature was normal and the blood pressure was 165/110. Examination of the chest showed an enlarged heart. There were moderate abdominal resistance and tenderness, such as might be expected from trauma to the abdominal wall. There was no abdominal pain or colic. The patient had a large right inguinal hernia with a large scrotal sac in which no intestine was present.

The blood count was normal. Fluoroscopic examination showed cardiac enlargement, hypertensive in type, and some restriction of motion of the left diaphragm. Radiographic examination of the abdomen showed a sharply localized area of small bowel distention in the right lower quadrant. No fluid level was noted in the erect film.

During the ensuing two days, the abdomen became more tender and distended, ascites was clinically evident, the temperature rose, and x-ray examination showed a progressive increase in the number and size of the distended loops of small intestine. Fluid levels appeared.

Fig. 15. Case 2. Early distention in a case of traumatic enteritis.

Fig. 16. Case 3. Dilatation of loops due to interference with blood supply.

Fig. 17. Case 4. Constriction of small intestine by a single adhesive band.

The admission diagnosis was traumatic enteritis, and expectant treatment was elected. After two days of increasing signs and symptoms, however, operation was performed. The abdomen contained considerable serosanguineous fluid. A segment of the ileum was ecchymotic and contained bloody fluid. There was considerable plastic exudate on the serosal surface. The involved segment was considered viable, however, and resection was not performed. Recovery followed a stormy postoperative period.

The interesting feature of this case is the rapid appearance in the presence of non-obstructive ileus of a locally distended segment of small intestine, eventually with fluid levels, of a character which could not, from the roentgen appearance alone, be differentiated from a mechanical obstruction.

CASE 3 (Fig. 16): G. J., a 35-year-old white male, was admitted with a history of abdominal pain for the past thirty-six hours. Intestinal colic was not present. There was generalized abdominal tenderness, most marked on the left side, where there was a suggestion of a palpable mass. The temperature was elevated, and there was a polymorphonuclear leukocytosis with a slight shift to the left.

The supine film of the abdomen showed multiple loops of distended small intestine. In the erect position multiple fluid levels were noted. The roentgen examination was compatible with intestinal obstruction of the mechanical type, but the clinical features were not in accord, unless a complicating lesion, such as strangulation, was also assumed.

Fig. 18. Case 5. Duodenal obstruction associated with rectal atresia in a four-day-old infant A. Supine film. B. Film made with patient inverted.

At operation a mass was found on the left side of the abdomen. A major portion of the omentum had slipped through a fibrous band crossing its base (the origin of the band was not apparent) and had become twisted, incarcerated, and gangrenous. Multiple loops of small intestine had become loosely adherent to the gangrenous omentum. They were moderately dilated, and their walls were edematous and purple. There was fluid, not definitely bloody, in the intestinal lumen. The loops of intestine were readily separated from the mass by blunt dissection. When all were freed, there was no diminution in caliber and peristalsis did not return during the period of observation. However, the intestine was considered viable. The omental mass was resected and the abdomen closed. A stormy postoperative course was expected, but convalescence was surprisingly uneventful.

It is apparent from this case that distention of the small intestine with multiple fluid levels is not of itself diagnostic of mechanical obstruction. The obstruction here was reflex in origin, since no block of the intestinal lumen was present.

CASE 4 (Fig. 17): E. G., a 74-year-old white female, had had a resection of the ascending colon, with ileocolostomy, two years previously for carcinoma. Except for constipation, she had been well until two days before admission, when crampy abdominal pain developed. There had been no bowel movement since that time. On admission, the abdomen was moderately distended and typical intestinal colic was present. There was no fever or leukocytosis, and no fecal impaction.

A supine film of the abdomen showed considerable air in the remaining colon, which, however, was not greatly increased in caliber, with multiple moderately distended loops of small bowel. (An erect film, unfortunately, was not made.)

A barium enema study was done in order to rule out the possibility of a second, possibly sigmoid, carcinoma. No abnormality of the colon could be demonstrated. Barium passed through the enterostomy stoma into the small bowel, which was distended with air and fluid. The exact site and nature of the obstruction could not be visualized. At operation the small intestine was found to be constricted just above the stoma by a single adhesive band. This was divided, and an uneventful recovery ensued.

Fig. 19. Case 6. Obstruction due to malrotation in a two-day-old infant.

In this case the obstruction of the small intestine, while sufficiently complete to result in intestinal colic and distention, was not complete enough to prevent air from passing into the colon. Apparently, therefore, in some cases, air may be present in the colon in considerable amounts in the face of a clinically acute small intestinal obstruction. Furthermore, clinically complete small intestinal obstruction may occur in the face of an incomplete obliteration of the intestinal lumen.

CASE 5 (Fig. 18): B. L., a 4-day-old slightly premature infant, was born with an imperforate anus. During the first two days of life the distention which should have appeared as a result of the rectal obstruction did not develop, and gavage feedings were repeatedly vomited. A supine film of the abdomen showed far less air in the intestinal tract than normal. The stomach and proximal duodenum were greatly distended, indicating a duodenal obstruction, which explains the absence of the expected distention which should have resulted had the rectal obstruction been present alone. A film in the inverted position showed the extent of the rectal atresia. (If operation is contemplated for repair of the anal defect, the roentgen examination should be made after the anal dimple has been marked with a small piece of lead, and a lateral view should be included, both views being made with the patient inverted.)

CASE 6 (Fig. 19): B. B., a 2-day-old infant, vomited within a few minutes of completion of each feeding. A gavage tube was readily passed into the stomach.

An x-ray examination of the abdomen showed an abnormally small amount of air in the intestinal tract. The stomach was not greatly distended. A film made twenty-four hours later showed a marked distention of the stomach and proximal duodenum. In these cases the absence of air in the small and large bowel is more important than distention proximal to the obstruction; the latter may or may not be evident, depending on the time the examination is made. Operation showed an obstruction of the duodenum due to malrotation.

CASE 7: V. Y., a 68-year-old white female, was admitted to the hospital complaining of abdominal pain and swelling. Her illness had begun two days earlier, with nausea and vomiting, but no pain. On the second day, severe diffuse abdominal pain appeared, which later in the day was limited to the lower abdomen. Chronic constipation, increasingly severe, had been present.

On examination dehydration was noted, with moderate abdominal distention. Tenderness was more or less diffuse. An occasional peristaltic tinkle was heard. Rectal examination was negative. The temperature was 99.4°; the white blood cell count was 10,030 cells per cu. mm., with 77 per cent polymorphonuclears.

An x-ray examination of the abdomen showed a moderate distention of the large bowel as far down as the sigmoid. No small bowel distention was demonstrable. The findings were thought to be compatible with a low obstruction of the colon. Examination by barium enema showed a redundant sigmoid, in which lay a number of large fecal masses. Barium flowed through this area with great difficulty, but eventually the whole colon was filled, and no other abnormality, except a moderate distention, was noted.

At operation, the colon was found to be distended; several distended loops of small bowel were also present on the right side of the abdomen. Two large, hard fecal masses were obstructing the sigmoid. The appendix was perforated, and a localized pelvic peritonitis was present. The appendix was removed, a drain was placed in the pelvis, and the fecal masses were broken up. Recovery took place.

While the exact sequence of events in this last case is unknown, it is felt that the chronic obstruction produced by the fecal impaction, with subsequent distention of the cecum and appendix, may have led to the appendiceal rupture.

CASE 8 (Fig. 20): W. P., a 56-year-old colored male, was admitted to the hospital complaining of swelling of the abdomen and vomiting. For the past four months he had noticed a gradual increase in the size of his abdomen and increasing frequency of urination. On the evening of admission he experienced intermittent, generalized abdominal pain and began to vomit. Constipation had always been present, and although there was a bowel movement on the day of admission, the material passed was scanty.

The blood pressure was found to be 160/100; temperature 100°. The abdomen was greatly distended and somewhat tender throughout. Peristalsis was infrequent but, when it occurred, was high-pitched in type. A distended bladder was readily palpable. The rectal examination showed the prostate to be only slightly enlarged. No masses were felt. The catheterized urine showed many white cells. The blood count was normal. A survey examination of the abdomen showed an extensive distention of the colon, with little or no gas in the small intestine. The cecum was not as distended as the descending colon. No air was seen in the lower sigmoid or rectum. On the basis of the history, physical findings, and x-ray appearance, a diagnosis of low obstruction of the colon was made. After several hours of slow decompression of the bladder had failed to alter the situation, a cecostomy was performed for the relief of the large bowel distention. The patient improved rapidly. Catheter drainage of the bladder was continued, and the urinary infection responded well to sulfadiazine.

Several days after operation a barium enema examination revealed a locally spastic sigmoid, but no evidence of obstruction. The examination was repeated several days before the cecostomy was allowed to close and again revealed no organic lesion.

This case demonstrates the advisability of a preoperative barium enema in all cases in which a diagnosis of large bowel obstruction is made from the survey examination, and shows how closely, under appropriate combinations of circumstances, a reflex ileus may resemble a mechanical obstruction.

CASE 9: L. L., a young colored female, was admitted to the hospital July 30, 1943, with the signs and symptoms of an "acute surgical abdomen." At operation, a ruptured tubal pregnancy was found The tube and ovary were removed.

During the first postoperative week, there were some vomiting and moderate abdominal distention. The temperature was not elevated. Gas was being passed by rectum, and peristalsis was present. By Aug. 6 the distention had not decreased and, while it was felt to be reflex in origin, the possibility of adherent loops in the pelvis was considered. Accordingly, Miller-Abbott intubation was effected. During the next three days the tube progressed satisfactorily, and the distention was reduced. The tube was removed on Aug. 11. X-ray examination the following day showed some residual small bowel distention, and vomiting reappeared. On Aug. 13, the patient was seized with acute abdominal pain, tenderness and rigidity appeared, and the temperature rose to 101.8°, with a pulse of 100. Operation disclosed a perforated jejunal intussusception about 2 feet distal to the ligament of Treitz. The operating surgeon felt that the intussusception was in the reverse direction and that it had probably been produced as the Miller-Abbott tube had been withdrawn, even though the tube had been removed with all precautions thought necessary to prevent this theoretically possible complication.

Fig. 20. Case 8. Distention of colon, simulating that seen in mechanical obstruction, in a case of reflex ileus.

Resection of the involved gut was carried out, and the patient recovered, although with a jejunal fistula. The latter was subsequently closed.

CASE 10 (Fig. 21): L. S., a 32-year-old white female, was admitted to the hospital complaining of severe abdominal pain. On examination the abdomen was moderately distended, with tenderness fairly well localized on the right side, somewhat above McBurney's point. The results of the rectal and pelvic examination were not available. Definite intestinal colic was not present; in fact, peristalsis was hypoactive. There was slight fever, and the leukocyte count was moderately elevated.

Fig. 21. Case 10. Local small intestinal ileus in a patient with pelvic inflammatory disease.

A survey film of the abdomen showed two sharply distended loops of small intestine, presumably ileum from their position and lack of distinctive markings, in the mid abdomen. The two loops together had a coffee-bean configuration. The markings between the loops appeared thickened, suggesting the presence of fluid.

The appearance of the loops was exactly the same in the film made in the erect position. They had not changed their configuration or position in any way. No fluid levels were present. Operation was advised, with the suspicion of local strangulation, even though the absence of fluid was against this possibility.

At operation, a bilateral salpingitis with a right ovarian abscess was revealed. Both tubes and the right ovary were removed. The distended loops of gut were not revealed through the incision, and because of the presence of pus, the surgeon elected not to explore the abdomen sufficiently to reveal them. The patient made an uneventful recovery, without any postoperative distention.

Fixation of loops of distended gut is usually interpreted as significant of strangulation or localized peritonitis, the latter being present in this case. The distention was certainly reflex in character, although the roentgen appearance—locally distended loops without fluid—is seen in early mechanical obstructions as well.

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DISCUSSION

Robert P. Barden, M.D. (Philadelphia, Penna.): This is a difficult subject to present and I think Dr. Osgood has done it in an extremely logical and well organized fashion. I would like to discuss just two aspects very briefly.

First of all, the most serious type of small bowel obstruction is apt to be the one with the fewest roentgen signs. I am referring particularly to cases with strangulated loops of small bowel or mesenteric thrombosis, and I believe we should be aware of this pitfall and not assume that a case with minimal findings and an "acute abdomen" cannot be a case of serious intestinal obstruction.

The second point I would like to emphasize is the danger inherent in the use of the Miller-Abbott tube. Dr. Osgood indicated that delay in decompression may be of more serious import to the patient's health than operation, even though the operation is performed when the patient is theoretically not in the best condition. I am sure that I have seen patients who have died as a result of inadequate use of the Miller-Abbott tube who might conceivably have lived if the tube had not been used. This is no criticism of the method, but it is a criticism of the way in which we as physicians may use it.

In order to insure proper drainage and positioning of the tube, it is essential that a team, in hospital practice, of a physician and a nurse be assigned to all patients in whom the tube is passed. Responsibility cannot be shifted from one service to another, and when the tube is in position, the maintenance of suction and proper use of both lumens in the tube are extremely important.

It is a very common thing to have the tube passed adequately, have the patient returned to his room or the ward, and discover, the next morning, that the suction has been applied without opening the stopcock or to the wrong lumen of the tube. There are so many factors in the mechanical use of the Miller-Abbott tube that require care that I cannot over-emphasize their importance.

I do not believe that the Miller-Abbott tube should be used for decompression in patients in whom obstructions of the colon have been

diagnosed. Very often back pressure in the colon will be sufficient to cause a perforation of the cecum before the tube reaches the lower ileum.

I do not believe that the Miller-Abbott tube should be used in patients suspected of gangrenous small bowel obstruction, because these patients require immediate operation and any delay may be fatal.

Ross Golden, M.D. (New York City): I would like to comment on one point in Dr. Osgood's paper, namely, the use of mercury in the balloon of the Miller-Abbott tube. This was suggested by Dr. F. I. Harris in an article published in 1944 (A New Rapid Method of Intubation with the Miller-Abbott Tube, J. A. M. A. **125:** 784–785, July 15, 1944). Before using it, I checked up with the Department of Pharmacology of the College of Physicians and Surgeons and with two or three of our internists about the possible dangers of absorption of metallic mercury. They felt that no danger from this source existed. We promptly adopted it at the Presbyterian Hospital in New York and since then have used it in at least 500 cases, if not more. In the first case in which it was used, the mercury was injected by one of our younger surgeons who was particularly interested in the problem of ileus. In so doing, he broke the balloon and the mercury was scattered through the small intestine. No effect whatsoever could be observed. Since then, in one or two other cases, a similar result has occurred. I believe that we can dismiss the probability or practical possibility at least of deleterious effects from metallic mercury in the small intestine.

We have found that the use of mercury assisted materially in getting the balloon through the pylorus. It is not necessary to use as much as 8 c.c; we have been entirely satisfied with 2 to 3 c.c. Furthermore, the weight of the mercury may be a handicap under certain circumstances. One cubic centimeter of mercury weighs 13.55 gm. and 2 c.c. weigh nearly an ounce. As the tube is going through the stomach, the position of the patient must be such that the tip of the tube is pointing toward the pylorus and such that the mercury falls to the distal end of the balloon. If the position of the patient is such that the mercury lies in the proximal end of the balloon, it may hold the tip back and may be a hindrance. I can recommend the use of mercury as an aid in getting the tube through the pylorus.

I agree with Dr. Barden that it is well to have a nurse and somebody on either the Medical or Surgical Service particularly interested in this procedure. At the Presbyterian Hospital we have a well trained nurse who inserts the tube and supervises the case as long as the tube is in the intestine. In a recent publication I suggested that in many institutions it would not be practical to have such a nurse and that the best supervisor would be the radiologist because he would see most, if not all, of the cases. This statement was mentioned in a review in the *Irish Journal of Medical Science*. The reviewer (I suspect he was a surgeon) had the horrors at the idea that the Miller-Abbott procedure should be supervised by the radiologist. However, I still believe the suggestion is good.

SUMARIO

La Sonda de Abbott-Miller en la Obstrucción Intestinal

El empleo de la sonda de Abbott-Miller representa un importante adelanto en el diagnóstico y tratamiento de la obstrucción intestinal. La descompresión del intestino distendido da lugar a un período más prolongado de preparación preoperatoria y puede transformar un caso de urgencia en un procedimiento electivo. El alivio de la distensión simplifica la intervención y la presencia de la sonda, por impedir la distensión postoperatoria y resguardar y la línea de sutura, ayuda a obtener una convalecencia tranquila y merma la posibilidad de complicaciones. En el vólvulo reflejo la sonda constituye un elemento terapeutico en sí misma y ha logrado resultados brillantes. En los procedimientos quirúrgicos que interesan el intestino grueso, el sondaje profiláctico ha resultado valioso, haciendo disminuir considerablemente la mortalidad operatoria. El empleo de la sonda está contraindicado en la estrangulación y la gangrena intestinal, que exigen la intervención cruenta inmediata, así como en las hernias externas y las obstrucciones del intestino grueso.

Expónese con minuciosidad la técnica de la introducción y manejo de la sonda a la vez que se describen los procedimientos de diagnóstico ejecutados con la introducción

de bario a través de la sonda, y que son principalmente útiles para determinar la presencia y grado de la obstrucción. No hay que atenerse a ellos como indicación o contraindicación de la operación, dado que algunas obstrucciones totales tal vez no exijan cirugía si, durante la descompresión, desaparecen los factores etiológicos, mientras que las obstrucciones parciales pueden persistir e imponer la intervención cruenta.

Cítanse estadísticas tomadas de la literatura que indican las ventajas del procedimiento y se analiza una serie de 53 casos de obstrucción del intestino delgado, en 34 de los cuales se usó la sonda de Miller-Abbott. Agréganse las historias clínicas de 10 casos.

El radiólogo dotado de adecuada experiencia clínica puede cooperar con el medico que le envía el caso en la formulación de un diagnóstico temprano de obstrucción intestinal y cuando emplea la sonda puede hasta participar en el tratamiento, variando su misión de mera orientación roentgenoscópica a responsabilidad más o menos absoluta por la introducción y atención de la sonda.

Bagasse Disease of the Lungs[1]

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and CAPT. A. LINK KOVEN, U.S.P.H.S.

BAGASSE is the name given to sugar cane after it has been crushed and the juice has been extracted. The term was originally used in Provence, France, to refer to the refuse from the olive-oil mills. Bagasse disease of the lungs, or bagassosis, is a pulmonary disorder brought about by the inhalation of dried bagasse dust. It is a rare disease, with only some 30 to 40 cases reported in the medical literature, having been first described in 1941 by Jamison and Hopkins (8), of New Orleans.

So far as is known today, the disease occurs only in people who have been exposed to the inhalation of dried bagasse dust. Industrial engineers have been aware that exposure to the dust was an industrial hazard, but very few physicians are cognizant of this fact. The fibers of bagasse are tough and possess insulating properties, which explains its use in the manufacture of acoustical and thermal insulating building boards and materials. More recently it has been used in the production of refractory brick.

Two factors are largely responsible for the lack of widespread information about bagassosis. In the first place, most of the reported cases occurred in men who handled bagasse derived from sugar cane grown in Louisiana, and the disease has been localized to certain communities. In the second place, men handling or cutting the finished products have not developed the disease because the heat and manufacturing processes destroy the fungi and bacteria as well as possible allergic protein, and the dust hazard in the modern fac-

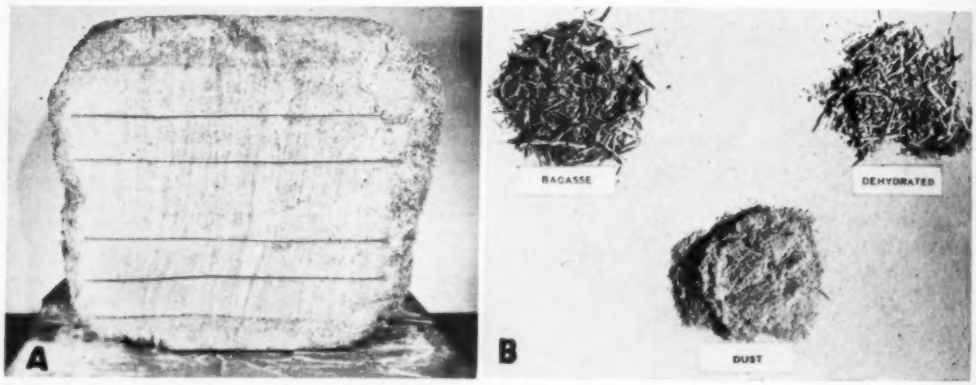

Fig. 1. A. The bagasse is shipped from Louisiana in tightly compressed bales. The first stage in processing it consists of breaking up the bales and grinding up the bagasse into small fibers or fine powder. This process is extremely dusty and is a serious industrial hazard unless special precautions against the dust are taken or the bales are broken up under water.

The photograph is of a bale of "dehydrated" bagasse, which is much less dusty and which is said to be less hazardous in handling.

B. Three different forms of bagasse: 1. Bagasse as it appears when broken free from the bale. Notice that it is a mixture of large fibers and very fine dust particles. 2. A collection of bagasse dust which was removed from the rafters and beams in the grinding room. This dust is a very light fine brown powder. 3. Dehydrated bagasse has most of the fine particles of dust and dirt removed, leaving chiefly the larger fragments of cane.

[1] From the Mallinckrodt Institute of Radiology, Washington University School of Medicine, Saint Louis, Mo., and the Department of Radiology, Missouri University School of Medicine, Columbia, Mo. Presented at the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–6, 1946.

TABLE I: COMPOSITION OF TISSUES OF SUGAR CANE*

Constituent	Pith, %	Bundles, %	Rind %
Ash	1.68	3.58	1.64
Fat and wax	0.41	0.72	0.98
Protein	1.94	2.00	2.19
Pentosans	32.04	28.67	26.93
Cellulose	49.00	50.00	51.09
Lignin	14.93	15.03	17.17

* From Browne, C. A.: Chemical Composition of Bagasse Dust. J. Am. Chem. Soc. **26:** 1221–1235, 1904.

tories has been largely eliminated. These conditions have restricted bagassosis to the communities which grow sugar cane and process it into sugar, such as Louisiana, or to the cities where the bagasse is manufactured into building board, as in England, or where it is used in making refractory brick, as in Missouri. Bagassosis also occurs in men employed in the Cuban sugar industry, where much dust is produced in handling sugar cane at the time it is cut. According to Manas (10) the Cuban disease is identical with that induced by the bagasse dust derived from Louisiana cane. In the Hawaiian Islands, bagasse is used for fuel, in a safe manner apparently, for we were unable to find reports of cases observed there.

Bagasse dust (Fig. 1) consists for the most part of pith particles with some bundle and rind fibers. The chemical analysis of samples of bagasse varies slightly depending upon the virility and agronomic factors, such as the soil, fertilizer, etc. Hunter and Perry (6) state that bagasse yields from 3 to 4 per cent ash and that 50 per cent of the ash is amorphous silica. Also that microscopic and x-ray diffraction analysis of the ash yields 3 to 4 per cent silica. This is an insignificant amount, and even if the ash were 100 per cent silica, it would still be regarded as a nuisance dust. Hence, it is improbable that the minute quantity of silica is an etiologic factor in the development of bagassosis.

Table I gives the approximate chemical composition of the tissues of Louisiana purple cane on the basis of the percentage of dry matter; Table II gives the approximate chemical composition of bagasse obtained from Louisiana purple cane.

SYMPTOMS AND CLINICAL COURSE

The symptoms and clinical course of bagassosis are variable and depend largely on the length of exposure and the density of the inhaled bagasse dust. A bacterial and mycotic examination of bagasse is difficult because it is a complex organic substance and has mixed with it dirt and fertilizer, is invaded by bacteria, and is subjected to fermentation processes while the sugar cane is lying in the open field. At present, Dr. Morris Moore is undertaking these studies and has cultured several different kinds of fungi, as well as different bacteria, but his results are not yet available. To give a little idea of this problem, Hunter and Perry (6) estimated that 1 gm. of the air-borne bagasse dust contained 240,000,000 fungal spores, and they isolated some twenty different species by culture methods.

TABLE II: COMPOSITION OF CANE FIBER (BAGASSE)*

Cellulose	55%
Xylan	20%
Araban	4%
Lignin	15%
Acetic Acid	6%

* From Browne, C. A.: Chemical Composition of Bagasse Dust. J. Am. Chem. Soc. **26:** 1221–1235, 1904.

A review of the various case reports brings out certain characteristic features. In general, about two months of exposure to the dust are required before symptoms appear, although the time has varied from three weeks to two years (14). The disease manifests itself as an acute febrile illness with extreme shortness of breath, a persistent cough with scanty mucoid sputum, and a profound weakness. The onset is insidious and gradual, for these patients usually do not realize that they are ill until they are seized by a sudden coughing spell and become so dyspneic as to force them to rest. The dyspnea is extreme. The patient described in Case I required oxygen for nearly two months. He was also cyanotic, but as a rule cyanosis appears in only the most severe cases. The usual ap-

pearance is that of a patient with a severe bronchiolitis and pneumonia.

Patients with long exposures to heavy concentrations of the dust are critically ill. Among the 24 cases collected by Hunter and Perry (6) there were 2 deaths, a mortality rate of 8.3 per cent, which is sufficiently high to indicate that this is an industrial disease of a serious nature. On the other hand, most of the patients with only moderate or short exposure to the dust in light concentrations contract a less severe form of the disease, which usually clears up in two to six months.

PHYSICAL FINDINGS AND LABORATORY EXAMINATIONS

At the onset the fever may range from 37° to 39° or 40° C. and persist for as long as two to three months before gradually subsiding. The pulse rate is correspondingly elevated. The respiratory rate is increased, ranging from 20 to 40. The supraclavicular and infraclavicular areas on the anterior chest wall may be retracted on inspiration. Percussion of the chest reveals a slight decrease in resonance. The breath sounds are not decreased, while the whispered voice may be increased, depending on whether or not areas of confluent consolidation have developed in the lungs. More important are the moist crepitant râles that are heard throughout both lungs. The cardiovascular system is unaffected. The mucosa of the nasopharynx is not injected. There is no enlargement of the lymph nodes, and the liver and spleen are within normal limits.

During the acute phase of the disease in severe cases, the white blood count may reach 16,000 to 20,000; in the moderately severe cases it may run around 10,000 to 12,000. As the pulmonary process clears, the number of white cells gradually declines and returns to normal. In the differential count there is a definite shift to the left, with the polymorphonuclear cells forming 70 to 90 per cent of the total. Of special note is the fact that an eosinophilia is usually present. The average eosinophil count in the 11 cases reported by Sodeman and Pullen (14) was 3.5 per cent. In our Case I the eosinophils ranged from 4 to 8 per cent. The red blood cells and hemoglobin are not affected. The blood chemistry determinations are within normal limits. Agglutination tests for coccidioidomycosis, typhoid, etc., were all negative in our patients. Repeated attempts at culturing the sputum for fungi were also negative, as has been the experience of most other observers. Microscopic examination of the sputum did not reveal any abnormal cells or recognizable fungi or spores, but small highly refractile bodies were repeatedly seen in the sputum, and these may have been fragments of bagasse.

Examination of sputum concentrates has never revealed acid-fast bacilli. Injections of the sputum into guinea-pigs failed to produce evidence of tuberculosis. Urinalyses were always negative. The sedimentation rate was definitely elevated in Case II, a finding which has been reported by others.

RADIOGRAPHIC APPEARANCE

Radiographic findings in bagasse disease of the lungs are largely dependent on the duration of exposure to and the concentration of the bagasse dust. In patients who receive a prolonged exposure to heavy concentrations of the dust an extensive fine punctate infiltration develops throughout both lungs. In our series the most extensive pulmonary infiltration occurred in Case II. The punctate type of infiltration tends toward a nodular appearance as the disease begins to clear up. In the beginning, the infiltration is so dense that areas of consolidation develop, usually about the hilum and/or in the adjacent portions of the lungs. The infiltration pattern is not sufficiently characteristic to enable one to make a diagnosis of bagassosis by merely examining the film. In this disease one must follow the old dictum: "There can be no radiographic diagnosis of bagasse disease of the lungs without a history of exposure to bagasse dust."

The one remarkable radiographic feature of this disease is that the process of pul-

monary infiltration, as observed on the roentgenogram, is a reversible one. This characteristic distinguishes bagassosis from the other pneumoconioses, in which a permanent fibrosis of the lung develops. Approximately two months are required from the time that the disease is at its height and exhibits the largest amount of infiltration in the lungs before appreciable resolution can be detected on the roentgenogram. By three months only minimal changes remain, and in five to six months the lung fields appear normal roentgenographically.

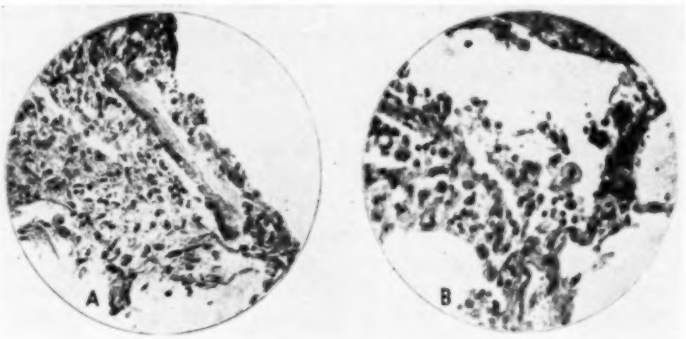

Fig. 2. Photomicrographs of biopsy specimens of the lung obtained by aspiration through a large needle in the sixth and seventh week. These are the only pathological sections available for the study of the pulmonary changes in bagasse disease. They are reproduced from Sodeman and Pullen (14), who describe a fibroblastic reaction of the interstitial tissue with small needle-like spicules of an irregular foreign material imbedded in the pulmonary tissues. The spicules are not numerous. Under the polarizing microscope these spicules rotated the plane of light and they appeared similar to particles of bagasse. These authors point out that the alveolar cells are numerous, very large, and possess a "foamy" cytoplasm and in some areas fill the alveolar spaces.

This period of resolution can be well visualized by following the serial roentgenograms in Cases I and II, as reproduced in Figures 3 and 4, respectively.

Patients receiving short or intermittent exposure to bagasse dust in lighter concentrations may develop only a fine granular type of bronchial infiltration throughout both lungs, slightly heavier in the areas immediately about the hilum or, as in Case III (Fig. 5), in the lower and medial portions of the left lung. On close examination, this type of infiltration bears a close resemblance to the fine lacy network that is sometimes formed by residual lipiodol in the alveoli. This is in conformity with the pathologic reports of the lung biopsies (Fig. 2), which demonstrate cellular debris in the alveoli and in the bronchioles, and agrees to some extent with the clinical impression that these patients have an acute bronchiolitis and pneumonia. This patient (Case III) received an intermittent exposure to bagasse dust for over a year, but on removal from contact with the dust, his pulmonary symptoms disappeared and we presume that the findings in the roentgenogram did likewise, although a follow-up film was not made until a year later. At that time, the lung fields appeared to be within normal limits.

PATHOLOGY AND ETIOLOGIC FACTORS

Material for pathologic examination is limited, as only two deaths from bagassosis have been reported. Sodeman and Pullen (14) were fortunate enough to obtain sections from the lung of one patient at autopsy and from another by lung biopsy obtained with a 20-gauge needle. Photomicrographs of the biopsy specimens are shown in Figure 2. They are described by these authors as showing a fibroblastic reaction of the interstitial tissue with small needle-like spicules of an irregular foreign

material imbedded in the pulmonary tissue. The spicules were not numerous and averaged 2 × 8 microns. When examined under the polarizing microscope, they rotated the plane of the polarized light and, microscopically, appeared similar to particles of bagasse. The alveolar cells were more numerous, were very large, possessed a "foamy" cytoplasm, and in some areas filled the alveolar spaces. The authors summarized these observations by saying that the pulmonary changes appeared to represent an organic pneumoconiosis.

The exact etiology of bagasse disease is obscure, but one fact is certain; namely, that exposure to dried bagasse dust can initiate a pathologic process in the lungs. The mechanism by which these changes take place and the reaction induced by the bagasse remain unsolved. To date, the disease has not been reproduced in experimental animals. We have made several attempts to do this and are now constructing additional equipment with which we hope to be more successful.

In their study of this disease, Jamison and Hopkins (8) were able to grow a fungus from two sputum cultures on one patient, but they did not describe its type or characteristics. Castleden and Hamilton-Paterson (1), as well as Gillison and Taylor (4), failed to isolate a fungus from the sputum of their patients. Others and ourselves have cultured various fungi from the sputum but have considered them to be contaminants or not associated with the disease.

A pulmonary disease known as maple bark disease is caused by the inhalation of fungi which grow on dead maple trees that have been cut for over a year. The patients are dyspneic, lose weight, have a productive cough with varying amounts of sputum, and fever ranging to 103° F., with night sweats and substernal pain. The clinical picture and chest roentgenograms closely resemble those of bagassosis, but all efforts to identify a similar spore in bagasse dust have failed to date. In the opinion of Towey, Sweany *et al.* (15) the reaction to the spores was due to a local toxic effect and foreign body reaction combined with a delayed effect resembling protein sensitization in certain clinical and immunological aspects. Fawcitt (2) gives a long list of pulmonary mycotic infections that appear in agricultural workers, such as hay workers, grain workers, stablemen, cattlemen, etc. Thus, the possibility that bagasse disease may be due to a fungus has some precedent in other diseases, but there is no clear evidence to support this idea at the present time.

Another possibility is that a bacterium in the bagasse dust may be the inciting factor, similar to that which appeared in the stained cotton of the 1940 crop that was used in the English upholstering and mattress plants where the workers were exposed to high dust concentrations from the cotton. Schneiter *et al.* (12) examined samples of the cotton and found a gram-negative bacterium which was the etiologic factor. This disease, however, required an exposure to the dust of only one to six hours and was characterized by a sudden onset with an acute phase lasting twenty-four hours, irritation of the nasopharynx, cough, chills and fever, with all the symptoms disappearing in a few days. In this way it is quite distinct from bagassosis, in which no specific bacterium has yet been isolated. It was further suggested that an endotoxic-like substance might be produced by the bacterium, and, that this, when inhaled, was the etiologic factor.

The first investigators to suspect an allergic reaction as the cause of bagassosis were Castleden and Hamilton-Paterson (1). They prepared four types of extracts from bagasse for intracutaneous injection. Three patients gave positive reactions, and a group of controls who did not have bagasse disease gave negative results with the saline extract. It was concluded that the acute phase of bagassosis is possibly an allergic response in the lungs to this antigen with, but more probably without, an infective element; also that the pathological process could be: (*a*) a form of silicosis which supervenes upon the al-

lergic phase during or after the resolution of the latter; (*b*) a response on the part of the lung to the crystalline cellulose in the bagasse; (*c*) a chronic process of fibrotic nature occurring in tissues which have become edematous from their allergic response to the antigen.

Sodeman and Pullen (13) repeated the tests conducted by Castleden and Hamilton-Paterson, using extracts made from bagasse according to their directions. Ingestion of these extracts produced similar reactions in all patients and controls, and the investigators concluded that the reactions were an irritative phenomenon due to the release of histamine and did not necessarily indicate a sensitization to bagasse.

Allergic pulmonary disease is well known, such as the syndrome described by Löffler (9), the symptoms of which resemble those of bagassosis and include cough, fever, leukocytosis, eosinophilia, and an elevated sedimentation rate, while the chest radiographs reveal transient areas of consolidation that appear and disappear rapidly. Furthermore, these patients have attacks of asthma, only a few râles are present in the lungs, and the disease clears up in about a week.

From these studies, the possibility that bagasse disease may be an allergic pulmonary reaction *per se* or a contributing factor cannot be ruled out, but evidence in favor of this view is not very strong.

Tuberculosis does not need to be considered as an etiologic factor in the absence of tubercle bacilli and negative tuberculin tests.

In summarizing the etiologic factors of bagassosis, one must conclude that it is an acute bronchiolitis and pneumonia due to bagasse dust. Whether or not the pathologic reaction is due to fungi, bacteria, or a virus associated with the dust, or to an allergic response to the bagasse or its possible infectious agents or their products, or to some chemical or physical property of the dust, or any combination of the above, has not been determined and is still open for investigation.

TREATMENT

In view of the obscurity of the exact etiology of bagassosis, there is no specific treatment. Most of the patients have been treated symptomatically. There was no notable response among those in whom the "sulfa" drugs were tried or in the one case treated by penicillin. Oxygen has afforded some relief of the dyspnea in the more serious cases.

CASE REPORTS

CASE I (Fig. 3): R. R. H., a 27-year-old white, married, firebrick worker, was transferred to this hospital by ambulance on May 18, 1946. From 1942 until August 1945, the patient was in the Army. He had been overseas and had served in North Africa, Sicily, and Italy. He was returned to this country in 1945 and was discharged in August in good health.

In January of 1946 he started working for a firebrick company. His work consisted of breaking up bales of bagasse that had been shipped from Louisiana and shoveling it into a "shredder," a machine that breaks up the larger bundles of bagasse and grinds it into a fine powder. This operation was conducted in a room with one side open to the outside, but it was extremely dusty even when the bagasse was dampened with water or mixed with wet sawdust. The patient usually wore a mask which covered his nose and mouth, but at times he removed the mask and received numerous exposures to the dust without any protection.

About the first of April, after three and a half months of exposure, a dry, hacking cough developed and by the middle of April the patient was dyspneic on even mild exertion. At that time he experienced two chills on successive nights, and on coughing he brought up small to moderate amounts of foul, black, watery sputum which, he said, contained black specks of bagasse. The sputum continued to be of this type for only a few days and then became mucopurulent, containing a few specks of blood; it amounted to approximately one-third of a cup per day. At the same time the patient became very weak and could hardly get out of bed. Fever began at the time of the chills and persisted throughout the course of the illness.

On April 19, the patient entered a local hospital and an x-ray examination was made of his chest, revealing an extensive bilateral infiltration of both lungs, which was described as a "snow-storm." He remained in the hospital about one month, during which time he received penicillin and oxygen, but he continued to become weaker. The chills and fever persisted and he had profuse night sweats. His weight decreased from 160 to 130 pounds. On May 18, 1946, he was transferred to this hospital for

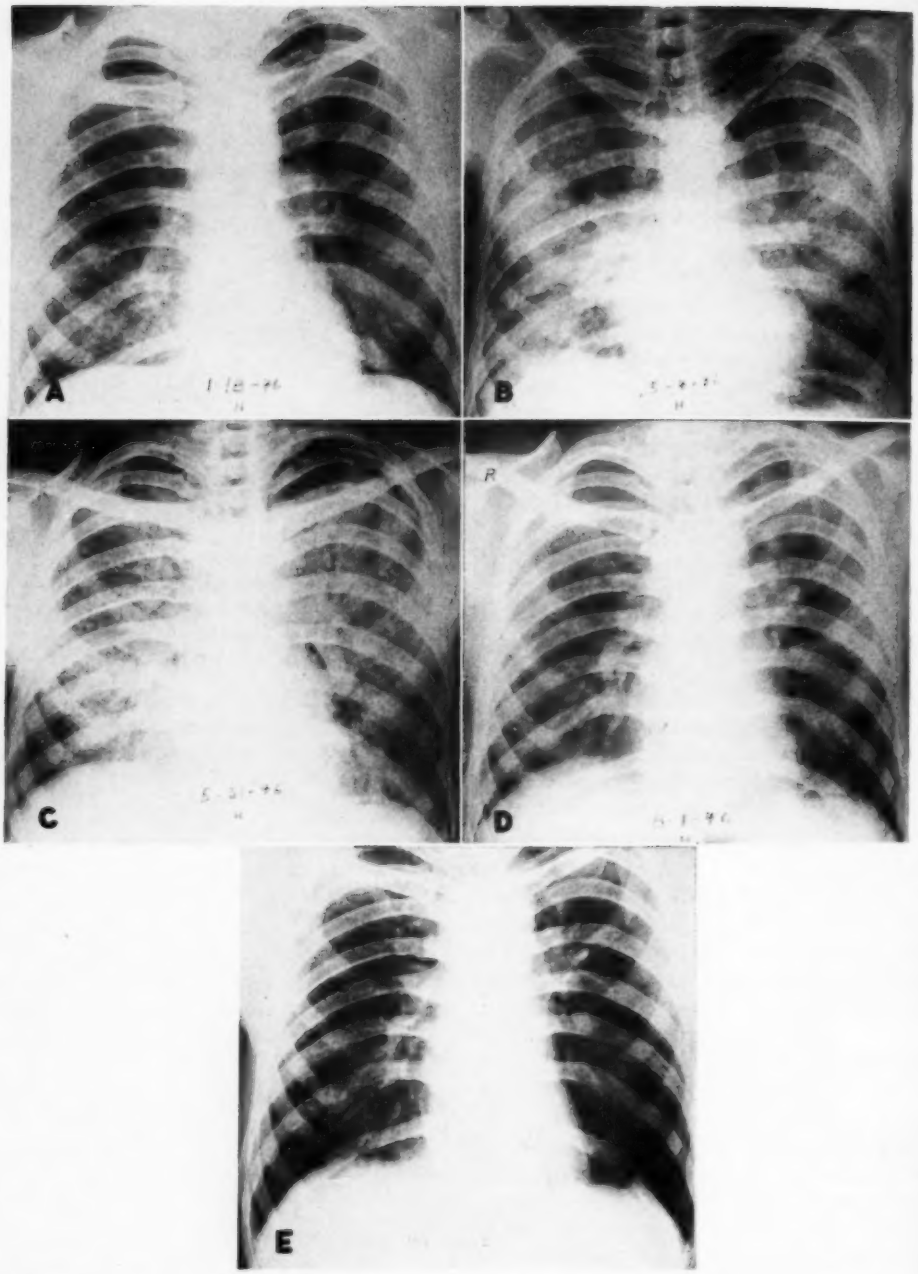

Fig. 3. Case I. Typical course of acute bagasse disease of the lungs, showing the changes that take place in the lung over a period of approximately six months.

A. The pre-employment film, which was considered to be normal.

B. Film made approximately one month after the patient became acutely ill following a period of three and a half months of exposure to bagasse dust. Note the symmetrical distribution of the small punctate areas of pulmonary consolidation and the peribronchial thickening in both lungs. The greatest change is about the hila and in the middle thirds of both lungs. The initial film, made in April 1946, was not available for reproduction, but appeared approximately the same. The patient was extremely ill and required continuous oxygen therapy. [*Legend continued on opposite page.*]

further study. On admission he had a temperature of 39.3° C., pulse 104, respirations 24, and blood pressure 110/78. He was dyspneic and orthopneic. He appeared acutely and chronically ill and was receiving continuous nasal oxygen. He did not complain of pain. He was not cyanotic.

Examination of the chest revealed marked retraction of the chest wall in the supraclavicular areas on inspiration. The percussion note was dull over the entire thorax. Tactile fremitus was unchanged. The breath sounds were loud, and many dry and coarse râles were heard in all areas. The whispered and spoken voice sounds were somewhat diminished. The heart was within normal limits. The rhythm was regular and the sounds were of good quality. The abdomen was slightly distended; the liver was slightly enlarged; the edge of the spleen could be felt. No other findings were obtained on physical examination.

The reports of the blood studies were as follows: red blood cells 5,000,000; white cells 18,150; hemoglobin 13.5 gm.; differential count, basophils 5, eosinophils 8, juveniles 3, stabs 7, segmented polymorphonuclears 67, lymphocytes 11. The sputum was white, frothy, and mucoid. On microscopic examination it was reported that several refractile bodies were seen, but no one was able to identify them. Repeated examinations of concentrated sputum specimens were all negative for acid-fast bacilli. Repeated cultures of the sputum were negative for fungi and contained only those organisms that are usually present. Urinalyses were all within normal limits. The blood Kahn reaction was negative. A culture of the blood failed to grow any organisms. Blood chemistry analysis, including the icterus index, was within normal limits.

Skin tests were made with 1,000-unit extracts of several molds, including aspergillus, which gave immediate negative reactions. A skin test for coccidioidomycosis with 0.1 c.c. of 1:1000 dilution was negative at both twenty-four and forty-eight hours. The electrocardiogram was within normal limits.

By the first of June the patient began to feel better. His temperature dropped to normal. The respiratory rate decreased. A chest film made at this time revealed the same type of miliary infiltration throughout both lungs, but to a less extent than the original film made at the time of his admission to the first hospital in April. It was necessary to keep him supported with oxygen, as otherwise he became very dyspneic and was troubled by a constant cough. His extreme weakness persisted. He was treated symptomatically, and penicillin was continued empirically through June 6, but it is doubtful if it was effective in the treatment. It was used because the patient was seriously ill and his clinical picture suggested a pneumonia or pulmonary infection. The white blood count had now dropped to about 13,000.

By July 5 the patient was able to get along without oxygen and to be up in a wheel chair. Only a few râles persisted throughout the lungs. He was coughing less and was gaining back his strength. The vital capacity was determined at this time and amounted to 1.8 liters, which was about 42 per cent of normal. This increased to 2.0 liters by July 11, at which time the patient was discharged. He returned to his home and continued to gain strength. The non-productive cough persisted, and on Oct. 7, without any apparent reason, he coughed up about a cupful of bright red blood. He was sent back to the hospital on Oct. 27 for a bronchoscopic examination. This was done by Dr. A. C. Stutsman, who was unable to find any bleeding point or source of the hemorrhage. He mentioned that the bronchi appeared to be thickened and grayish in color, with slight injection of the mucosa. A small amount of seromucoid secretion was present in the main bronchi. The vital capacity was retested and had now increased to 3 liters. The venous pressure was 108 mm. of saline. The circulation time (arm to tongue) was 15 seconds with decholin.

CASE II (Fig. 4): E. L., a 42-year-old married colored laborer, had worked for the same brick company as the man reported in Case I. His family history and past history are irrelevant. From August 1943 to Feb. 29, 1944, he worked in the dry press department where he was subjected to light exposure to silicate dust with very minimal free silica. He was discharged because of absenteeism. On April 4, 1944, he was rehired and worked in the insulation department, where he was exposed to ground dry bagasse dust until June 29, 1944, an exposure of eleven weeks. He had no previous history of any respiratory condition or pleurisy and had never been sick before this present illness.

In the middle of May 1944, this man experienced an acute coughing and choking spell in the company cafeteria. He also noticed that he was somewhat

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C. The heavy areas of consolidation have undergone partial resolution. Note the fine granular shadows that correspond to consolidation in the air sacs of the lungs. The patient was now feeling better, but it was necessary to keep him supported with oxygen.

D. This film was made two weeks after discharge from the hospital and shows practically complete resolution of the miliary consolidation in both lungs. The patient was now able to be up and about but was still weak and coughing.

E. On Oct. 7, this patient coughed up a cupful of bright red blood. A bronchoscopic examination failed to reveal the bleeding point or source of the hemorrhage. The bronchial mucosa appeared to be normal and free of any excessive secretion. The vital capacity had increased to 3 liters, venous pressure was 108 mm. of saline, and the circulation time was 15 seconds with decholin. The patient had gained weight and within a few months was doing light work.

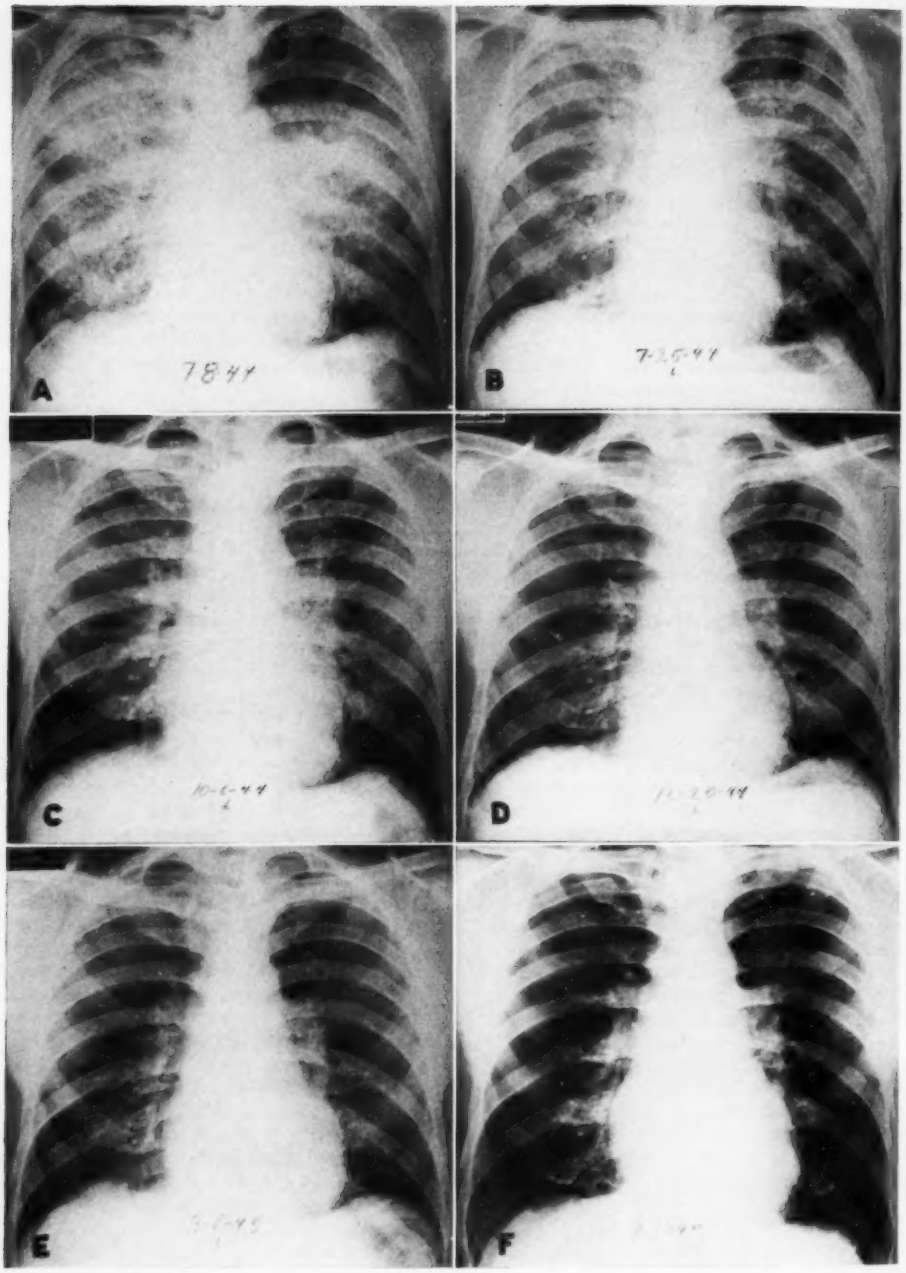

Fig. 4. Case II. Typical pulmonary changes in bagasse disease of the lungs with ultimate resolution.

A. The patient had been ill for two months prior to taking of this film. Note the bilateral involvement of the lungs, greatest about the hila. Areas of consolidation are present in the adjacent areas of the lungs. The characteristic features are the small patchy areas of consolidation in the smaller divisions of the lobules.

B. Definite resolution began to take place within the next two weeks, although the patient only brought up small amounts of clear, mucoid material. He was now beginning to feel better but was still quite ill. [*Legend continued on opposite page.*]

short of breath on exertion and realized that it was more difficult for him to do the manual labor that was required in his job. Shortly thereafter, he consulted a private physician, who had x-ray films made of the chest. These revealed an extensive miliary type of infiltration throughout both lungs, with areas of conglomeration and consolidation immediately about the hila. Fever was noted at this time.

On July 24, 1944, the patient was admitted to a sanitarium. Upon admission it was reported that he was dyspneic, with a temperature of 99.2° F., pulse 116, and respirations 28. He had lost about 25 pounds in weight. It is interesting that he thought his illness had developed gradually over a period of several months. He had repeated night sweats. He described the onset as characterized by cough, pain in the chest, and the spitting up of some blood, accompanied by chills and fever, with shortness of breath and a gradually increasing weakness.

On physical examination the patient appeared to be in a fair state of nutrition. The heart was within normal limits, but the rhythm was irregular. Blood pressure was 120/94. Many fine crepitant râles were heard over both lungs. The breath sounds were increased, as was the whispered voice.

Repeated sputum examinations were negative for acid-fast bacilli. The blood Kahn reaction was negative. Guinea-pigs were inoculated with the sputum on Aug. 10, 1944, and again on Oct. 21, 1944. Both animals were sacrificed, autopsied, and were negative for tuberculosis. The sputum was also cultured and was negative for fungi. On July 29, 1944, the vital capacity had fallen to 2.35 liters. The sedimentation rate was 22. Urinalysis was within normal limits.

From the time of his admission to the hospital until the middle of August, the patient had a fever ranging from 98° to 101° F. He was treated symptomatically and on about the same regime as patients with tuberculosis in the sanitarium. He gradually improved, the sputum became scant, and there was a gain in strength and weight. On Feb. 4, 1945, approximately seven months later, he was able to be discharged. The infiltration in the lungs, as demonstrated in the chest films, gradually cleared.

On May 25, 1945, the patient returned for a checkup. At that time he had no sputum, no cough, no chills, and no fever. He had nearly regained his strength. He had done no work since leaving the hospital and had been convalescing at home. Chest films at this time revealed only coarse markings, with little residue of the initial infection.

CASE III (Fig. 5): O. G., a 30-year-old white married laborer presents an interesting case, as he had only moderate pulmonary involvement as demonstrated roentgenographically. He gave a history of the usual childhood infections, as well as pneumonia. In 1941 he had a duodenal ulcer which continued to cause him trouble intermittently to the time of admission. During the x-ray examination of the gastro-intestinal tract the chest was observed fluoroscopically and was reported as negative. Early in 1944 he contracted undulant fever from which he recovered uneventfully.

Prior to his employment at the brick company, the patient worked for a year and a half in a coal mine. From 1939 to 1943 he was employed by a firebrick company in a position where he was exposed to moderate dust concentration of silicates. Late in 1943 he was transferred to another department, where he received intermittent exposure to a fairly heavy concentration of bagasse dust for about one year. At the end of that time, late 1944, he suffered from a cough which was non-productive, complained of slight substernal pain, was dyspneic on exertion, and felt weak. He continued to work, and his record shows that throughout his entire period of employment he never lost a day from sickness. He consulted a physician on Sept. 18, 1944, at which time a chest film was made. This physician reported exaggeration of the hilar markings, with a diffuse pulmonary fibrosis and a disseminated pulmonary infiltration throughout both lungs of an unusual type. The physician requested a more complete history with reference to dust and respiratory hazards. The patient was then transferred from the plant and given a position as a clerk, where he no longer was exposed to dust. His symptoms continued, and on Oct. 19, 1944, stereoscopic films were made of the chest and were interpreted as demonstrating a pneumoconiosis.

The symptoms gradually disappeared and the patient's strength increased. Another chest film was made on Sept. 22, 1945, when the radiologist reported that the punctate infiltration in the lung fields was much less evident and that the pulmonary infiltration was of a reversible type, and again requested that a detailed study be made of the dust exposure to which this man had been subjected.

The subsequent review of the dates of this patient's exposure to the silicate dust and later to bagasse dust, with the development of his pulmonary illness and the reversible changes in the lungs, as demonstrated on the roentgenograms, was the first suggestion that this was a case of bagasse disease of

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C. Small areas of pulmonary infiltration and peribronchial thickening remain in both lungs despite marked improvement. Cough was now non-productive and there was no fever or any other symptom.

D. Approximately eight months after the development of the disease, the lung markings are still coarse. The patient still complained of weakness and shortness of breath but was able to be up and around.

E and F. About one year after development of the disease the lungs have regained their normal appearance. The patient felt well and was able to go about his routine duties.

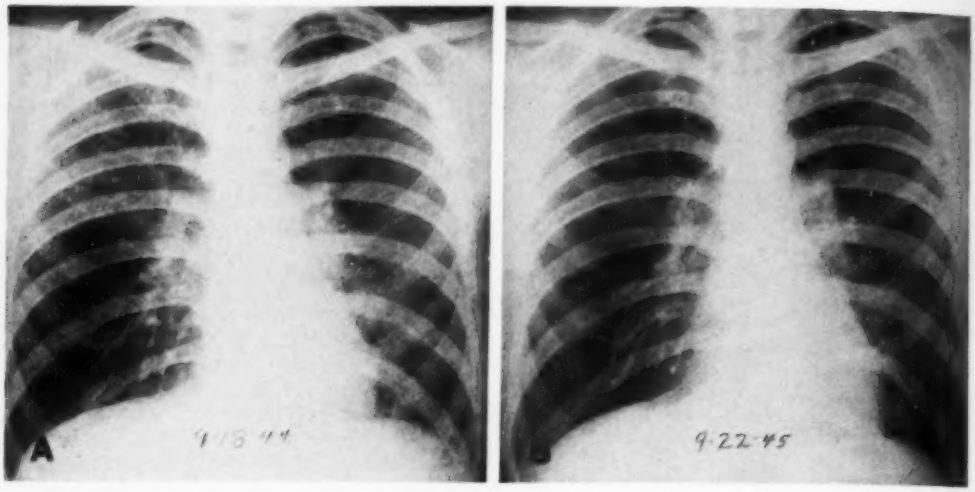

Fig. 5. Case III. Typical case of mild bagasse disease of the lung induced by intermittent exposure to a light concentration of bagasse dust over a period of one year.

A. After nearly a year of intermittent and light exposure to bagasse dust, this patient began to complain of a non-productive cough, with weakness, slight substernal pain, and shortness of breath on exertion. He continued to work and throughout his entire period of employment never lost a day from sickness. This film was originally reported as showing exaggeration of hilar markings, with a diffuse pulmonary fibrosis and a disseminated pulmonary infiltration of both lungs of an unusual type. The physician (D. L.) requested a full history with reference to dust exposure and respiratory hazards. The man was then transferred to a department free of bagasse dust.

B. Approximately one year later, this man was re-examined because of the findings noted above. The radiologist now reported that the punctate infiltration in the lung fields was much less evident and that the pulmonary infiltration was of the reversible type and, consequently, was something unusual and not a typical pneumoconiosis. This observation was the stimulus for an intensive check-up on the patient's exposure to various dusts and led to the incrimination of bagasse dust.

the lungs. This was the first patient that had been recognized as having the disease in this community and focused our attention on this industrial hazard. Today this patient is well and symptom-free. His chest film is well within normal limits.

CONCLUSIONS

1. Inhalation of bagasse dust, derived from sugar cane after it has been crushed and the juice extracted, incites a pathologic process in the lungs which has been termed "bagasse disease of the lungs," or "bagassosis."

2. Information concerning bagassosis should be disseminated because bagasse is being used more extensively in the manufacture of thermal and noise-insulating building materials and in the manufacture of refractory brick. As such, it constitutes a serious industrial hazard unless properly handled.

3. Pulmonary changes incited by the inhalation of bagasse dust consist in a diffuse infiltration and consolidation, an acute bronchiolitis or pneumonia, that is similar to that seen in pneumoconiosis but in one respect is greatly different. It is a reversible reaction, with the process undergoing resolution and the lung regaining its normal appearance on the roentgenogram.

4. The exact etiologic factors in bagasse disease of the lung are as yet unknown, and this problem is still open for investigation.

5. Three cases of bagassosis are reported, including a discussion of the symptoms, physical findings, laboratory reports, and clinical course.

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DISCUSSION

Capt. A. Link Koven, U.S.P.H.S.: As pointed out, the exact etiology of bagasse disease remains obscure. At least, we may conclude that bagasse may enter the alveoli and initiate a fibroblastic reaction and that by digestion and absorption, through the activity of cellular response, these changes are removed and a normal functioning lung (clear on x-ray examination) remains. In view of the obscurity of the etiology of bagassosis and the lack of specific treatment, chief reliance at present is in the provision of a dust-free environment, introducing either proper exhaust ventilation and water spray or a change to a wet method of collecting and breaking the bales.

Because of the industrial importance of the properties of bagasse, its use will extend to other purposes. It can be anticipated that the incidence of bagasse disease of the lung will increase. The U. S. Public Health Service is interested in promoting practices that will prevent this disease and also in determining its exact etiology.

The small number of cases that have been recognized and described does not necessarily mean that the number of cases of this disease is limited. On the contrary, the comparatively recent recognition of this entity and the lack of its differentiation from several other similar diseases have minimized its real incidence and significance. It is of importance that the nature and diagnostic features of bagassosis be made widely known among industrial physicians and roentgenologists.

SUMARIO

Bagazosis Pulmonar

La inhalación del polvo del bagazo que deja la caña de azucar después de triturada y privada de su jugo, evoca un proceso patológico en los pulmones, que ha recibido el nombre de bagazosis pulmonar o neumobagazosis.

La patología pulmonar provocada por la inhalación del polvo del bagazo consiste en infiltración y hepatización difusas y bronquiolitis o neumonía aguda, semejante a la observada en la neumoconiosis pero muy distinta en un sentido, pues se trata de una reacción reversible, en que el proceso experimenta resolución y el pulmón recobra su aspecto normal en la radiografía.

No se conocen todavía con exactitud los factores etiológicos de la bagazosis pulmonar, y el problema está aun en vías de investigación.

Preséntanse tres casos de bagazosis, con una reseña de la semiología, hallazgos físicos, informes de laboratorio y evolución clínica.

Debe divulgarse la información disponible acerca de la bagazosis, pues se va usando el bagazo cada vez más en la fabricación de materiales térmicos y anti-ruido para construcción, incluso ladrillos refractarios al calor y al ruido, y en esa capacidad constituye un grave riesgo industrial a menos que se manipule debidamente.

Symmetrical Calcification of the Cerebral Basal Ganglia

Its Roentgenologic Significance in the Diagnosis of Parathyroid Insufficiency[1]

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In 1939 EATON, Love and I (1) reported six cases in which symmetric calcification of the cerebral basal ganglia was observed roentgenographically. In two of these cases there was definite clinical evidence of spontaneous parathyroid insufficiency and tetany. In retrospect, our original case, which was reported (2) in 1938 would also seem to be an example of this condition, although the diagnosis was not established before death. The basic pathologic changes responsible for symmetric calcification of the cerebral basal ganglia have been noted by many writers since Bamberger's (3) and Virchow's (4) original observations in 1855. It was not until 1935, however, that the first report concerning the roentgenographic appearance *in vivo* was published. In that year Fritzsche (5) described the changes observed in roentgenograms of three siblings and Kasanin and Crank (6) presented the roentgenographic and postmortem findings in one case. None of these authors mentioned the presence of parathyroid insufficiency. The older literature contains reports of seven cases of parathyroid insufficiency (tetany) in which calcification of the basal ganglia was observed by pathologists (7–11). In most cases the process was marked and, if roentgenograms had been made, these would probably have presented the characteristics of symmetric cerebral calcification.

To date, at the Mayo Clinic, we have observed 12 cases of symmetric calcification of the cerebral basal ganglia in which there was definite clinical evidence of parathyroid insufficiency and tetany. In one, the calcification followed a thyroidectomy at the age of nineteen years; in the other 11, the disease was of the spontaneous type.

The pathologic basis for the roentgenologic changes is a colloid deposition in and around the finer cerebral blood vessels, with subsequent calcification of the deposits, which coalesce and form vascular sheaths and concretions (Fig. 1). There is general agreement as to the involvement of the media and adventitia of the smaller arteries and the infrequency with which the veins are affected. When the process is extensive, the capillaries may be occluded but the lumens of the arteries are rarely narrowed (Fig. 1 *b*). Ostertag (8) concluded that the deposited colloidal material occurs so frequently in the anterior half of the globus pallidus and in the dentate nucleus of the cerebellum that its presence to a slight degree, if not normal, is at least not unexpected. A marked increase in the degree and extent of the vascular process is likely to occur at any age, in either sex, and in response to many diseases, not all of which need produce neurologic symptoms. Calcium is always present microscopically to a considerable degree before it can be revealed by present roentgenologic methods. In 5 of the 12 cases presented herewith, deposits of calcium were observed roentgenographically in the deeper layers of the cerebral cortex as well as in the basal ganglia and cerebellum.

The pathologic changes have been most extensive and therefore are most likely to be detected roentgenologically in parathyroid insufficiency and other diseases characterized by mental deterioration with or without convulsive seizures or motor symptoms referable to the extrapyramidal system. Since adequate treatment of parathyroid insufficiency results in a marked improvement of the mental condition of the patient and stops the convulsions without

[1] Presented at the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–6, 1946.

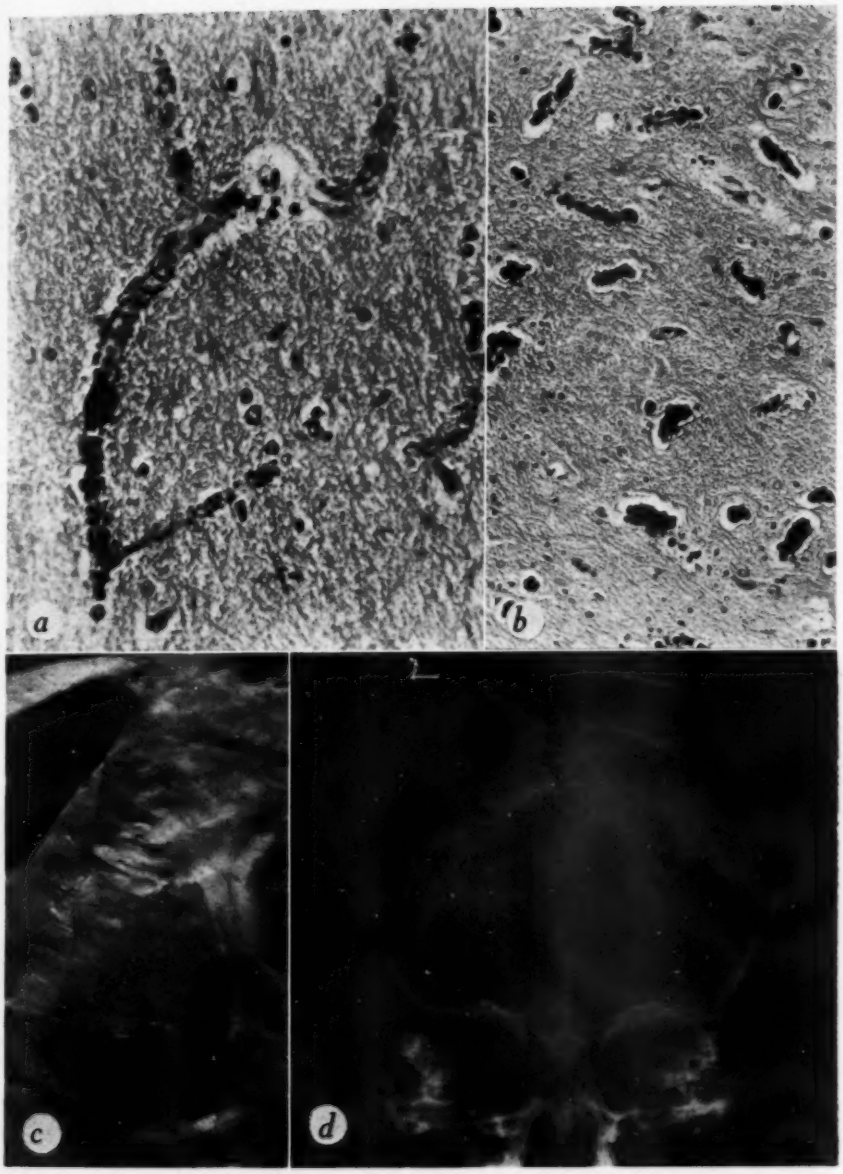

Fig. 1. *a*. Histologic changes in the thalamus; pericapillary colloid deposits and calcification (×340). *b*. Mulberry-shaped small concrements with obliteration of capillary lumens (×135). *c*. Gross coronal section revealing calcified nodules of sizes varying up to 3 mm. in their greatest diameter in the lenticular nuclei. *d*. Roentgenogram revealing symmetrical distribution and extent of calcification of basal ganglia shown in *a*, *b*, and *c*.

TABLE I: CLINICAL AND ROENTGENOGRAPHIC DATA IN TWELVE CASES OF SYMMETRICAL CALCIFICATION OF THE BASAL GANGLIA

Case	Sex	Age, years		Degree of Calcification as Determined Roentgenographically*		
		At Onset of Symptoms	When Observed at the Clinic	Basal Ganglia	Cerebrum	Cerebellum
1	F	6	27	+++	0	+
2	F	3	15	++	0	0
3	M	19	42	+++	+	+
4	M	42½	44	++	+	++
5	F	6	32	+	0	+
6	M	7½	13	+++	+	0
7	F	39	42	++	+	++
8	F	7	19	+	0	0
9	M	11	19	++	0	0
10	F	2½	2½	0	0	0
			11	++	0	0
11	F	11½	28	+++	+++	+++
12	F	5	28	+++	0	++

* + = Minimal degree. ++++ = Maximal degree.

producing roentgenographically detectable changes in the character of the cerebral or cerebellar calcification, it is apparent that the calcification itself is not responsible for the mental deterioration or convulsive phenomena (12).

SYMPTOMS

The symptoms in general include the various complications of chronic parathyroid insufficiency, namely, cataracts, convulsions, mental retardation, and trophic changes. In 3 cases tetany followed an attack of measles. Two of these patients were sisters, and the mother made the diagnosis of parathyroid insufficiency in the younger one because the symptoms were similar to those previously observed in the other. In one case (Case 10, Table I), in a girl two and a half years of age, the diagnosis of parathyroid tetany was made at the clinic in 1925. The values for the serum calcium as determined on two occasions at that time were 7.4 mg. and 8.4 mg. per 100 c.c. Roentgenographic examination of the skull was reported as negative. The patient had no attacks for one month following treatment and at that time was taken home. Nothing further was heard of her until ten years later (1935), when she was brought back to the clinic because of her mental condition. Since the child did not like the medication, it had been discontinued soon after her return home in 1925. When seen ten years later, she was markedly retarded both mentally and physically, and convulsions were occurring frequently. The values for the serum calcium on two occasions were 6.4 mg. and 6.0 mg. per 100 c.c. The value for serum phosphorus was 7.2 mg. per 100 c.c. Roentgenograms of the skull revealed symmetrical calcification of the cerebral basal ganglia. Because of her condition, the parents sent the child to a mental hospital for permanent care. It is interesting to speculate on how different the outcome might have been if the original prescribed medication had been continued. It is significant that in none of the 12 cases did a convulsion or "attack" occur after the institution of treatment for parathyroid insufficiency. Mental improvement was marked, and children previously retarded in school were able to keep up with their classmates and some have subsequently gone to college. These facts alone and the possibility of salvaging even a few of the mentally retarded and handicapped will justify the search for parathyroid insufficiency in the presence of roentgenographic evidence of symmetrical calcification of the cerebral basal ganglia.

ROENTGENOGRAPHIC FINDINGS

Symmetrical calcification of the cerebral basal ganglia produces a distinctly characteristic roentgen appearance (Fig. 2).

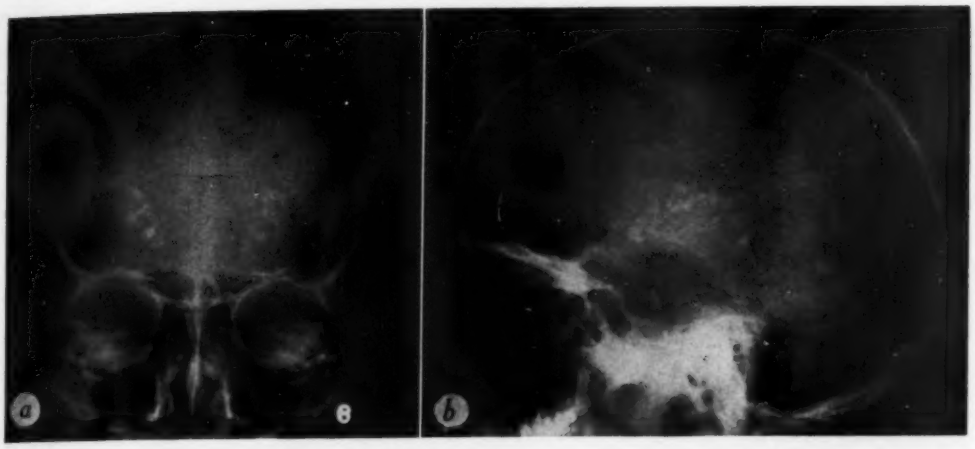

Fig. 2. Characteristic roentgenographic appearance of symmetrical calcification of the cerebral basal ganglia (spontaneous parathyroid insufficiency). *a*. Bilateral symmetrical distribution of the shadows of calcification. *b*. Extent of shadows of calcification.

Fig. 3. Minimal calcification in the cerebral basal ganglia. The symmetrical shadows of calcification shown in *a* might easily be mistaken for calcification in the choroid plexus. The shadows of calcification are partially obscured by the density of the overlying shadow of the bone in *b*.

Considerable variation in the degree and extent of this form of calcification may occur, corresponding to the stage of the disease at the time the roentgen examination is made. The first roentgen evidence of calcification consists in small, irregular, discrete, symmetrically distributed shadows of increased density in the region of the various basal ganglia, especially the putamen and caudate nucleus (Fig. 3). When the calcification is more marked, the irregular shadows take on a wavy linear appearance. This is especially obvious in the dentate nucleus of the cerebellum and in the folds of the cerebellar hemispheres (Fig. 4). As the masses of calcium coalesce, the roentgen shadows become larger, denser, and more obvious (Fig. 5). Coincident cerebellar calcification may be observed at any stage of the disease, as well as evidence

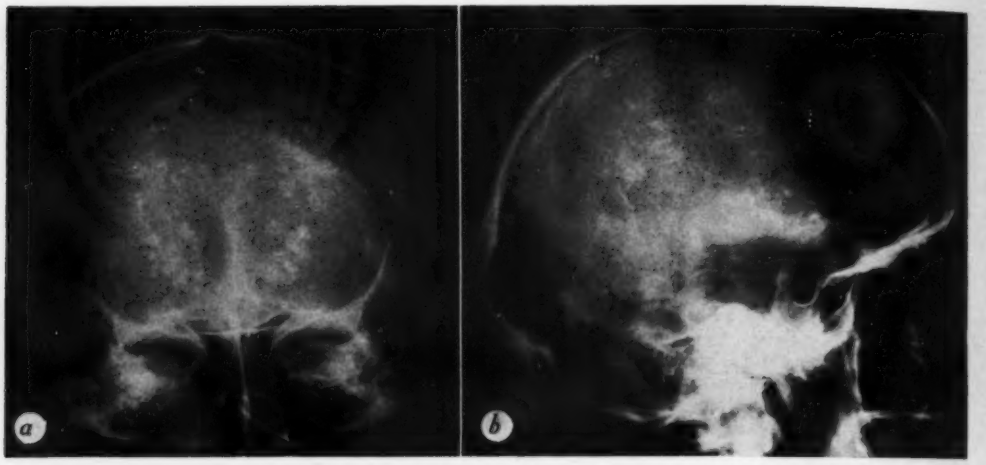

Fig. 4. Roentgenograms revealing extensive calcification of cerebral basal ganglia and cerebellum. There is also bilateral calcification in the cerebral cortex. Spontaneous parathyroid insufficiency.

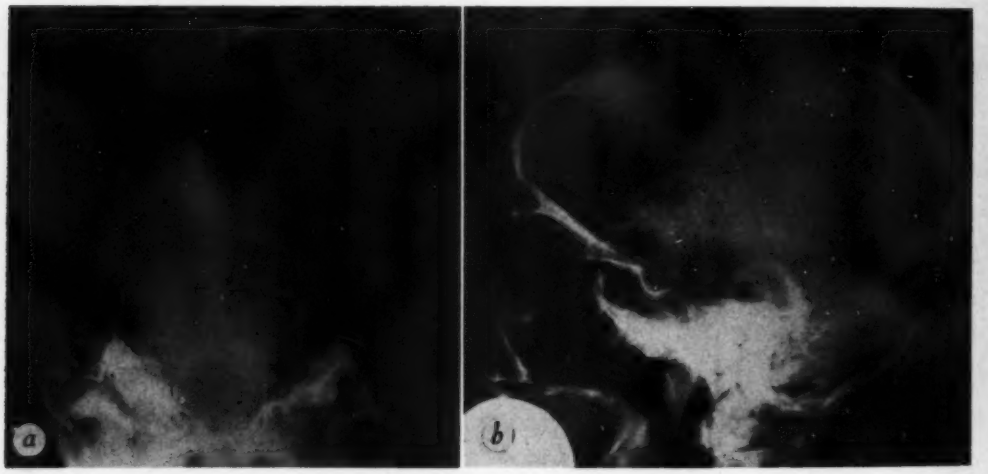

Fig. 5. Roentgenograms revealing extensive calcification of cerebral basal ganglia. Postoperative parathyroid insufficiency.

of calcification in the deeper layers of the cerebral cortex. The latter may be so marked as to simulate a vascular lesion or calcified glioma.

Roentgenographically, it is important not to mistake the shadows of calcification in the ganglia for evidence of a neoplasm. The fact that the shadows are bilateral and symmetric is usually sufficient to exclude the possibility of tumor of the brain. If there is any doubt, pneumographic studies may be carried out. With air in the ventricular system, the extraventricular position of the calcium shadows and their relation to the site of the basal ganglia will be well shown (Fig. 6). In spite of the mental symptoms, there was no roentgenographic evidence of other cerebral abnormality in the 4 cases of our series in which pneumographic studies were carried out.

Calcium deposits within the choroid plexus of the lateral ventricles are com-

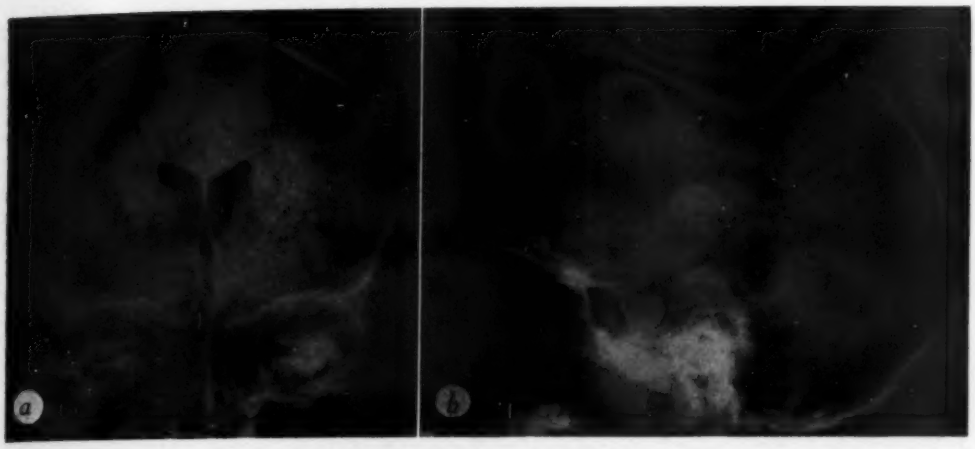

Fig. 6. Pneumo-encephalograms revealing relation of lateral ventricles to shadows of symmetrical calcification in the cerebral basal ganglia. Spontaneous parathyroid insufficiency. Same case as Figure 2, *a* and *b*.

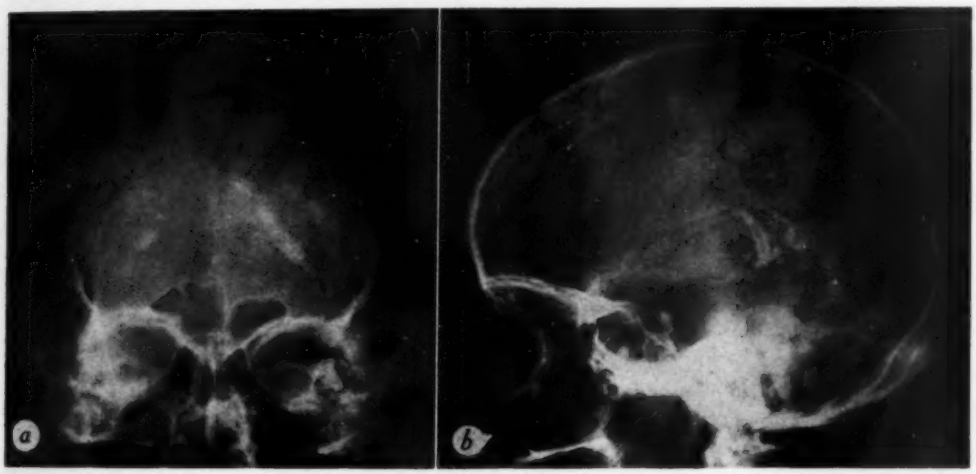

Fig. 7. Roentgenograms revealing extensive bilateral calcification of the choroid plexus. This may be mistaken for calcification in the lenticular nucleus. Roentgenograms also reveal a plaque of calcification in the falx cerebri.

monly observed in roentgenograms of normal persons. In certain anteroposterior roentgenograms, the bilateral shadows of calcification of the choroid plexus may simulate calcification of the basal ganglia. However, when roentgenograms made in the lateral position are examined, the distinction between the two conditions should be obvious, since calcification of the choroid plexus is usually limited to the region of the genu of the lateral ventricle, whereas calcification of the larger basal ganglia will be well anterior to this. When calcification of the choroid plexus extends into the temporal horn on each side, it may be difficult to distinguish from calcification in the lentiform nucleus, although this seldom occurs without obvious calcification in the putamen and caudate nucleus as well (Fig. 7).

As mentioned previously, calcification of the cerebral basal ganglia is not limited to

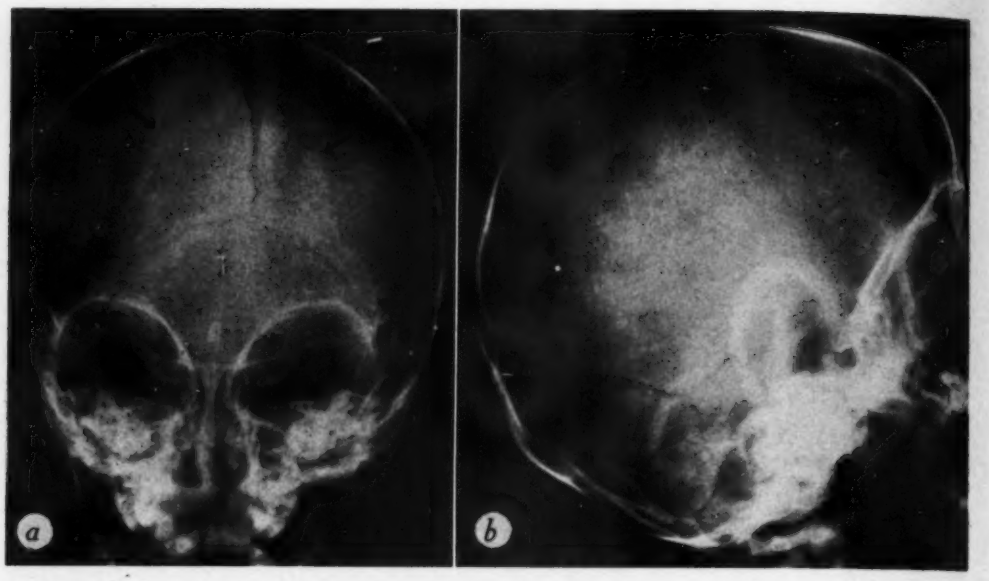

Fig. 8. Roentgenograms revealing symmetrical calcification of cerebral basal ganglia and extensive calcification in cerebrum. Encephalitis in infancy.

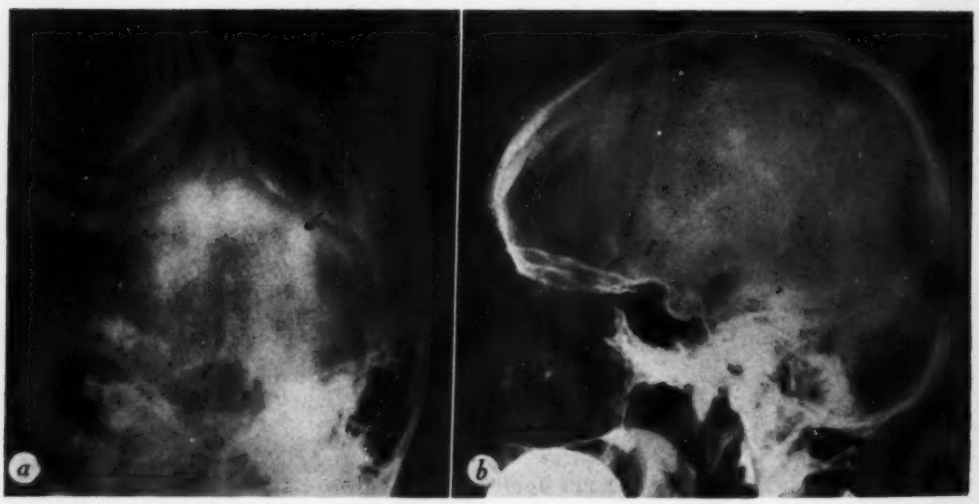

Fig. 9. Roentgenograms revealing symmetrical calcification of cerebral basal ganglia. There are also nodules of calcification elsewhere in the cerebrum and massive calcification in the right lobe of the cerebellum. Tuberous sclerosis.

patients with parathyroid insufficiency. In the course of this study, examples were observed in patients with a previous history of encephalitis, tuberous sclerosis, toxoplasmosis, and mental deficiency since birth. In one case in which the patient complained only of blepharospasm, there was no obvious cause for the presence of the calcification. In another case, in which the calcification was of minimal de-

Fig. 10. Roentgenograms revealing irregular nodular masses of calcium more or less symmetrically distributed in cerebrum, basal ganglia, and dentate nuclei of cerebellum. Toxoplasmosis in infancy. Identical twin brother had same condition.

gree, a mild hyperthyroidism and a positive Kahn test were the only positive clinical findings.

Patients with a previous history of encephalitis and evidence of calcification of the basal ganglia in almost all instances had evidence of other discrete areas of calcification throughout the cerebrum (Fig. 8). This was most obvious in infants, in whom the age, abnormalities of the calvarium, and wide distribution of the shadows of calcification at once suggested a diagnosis other than parathyroid insufficiency.

In tuberous sclerosis, calcification of the basal ganglia when present was always accompanied by nodules of calcification elsewhere in the brain. The latter predominated (Fig. 9).

In the presence of toxoplasmosis, the calcification in the basal ganglia appears to be very extensive, the calcium occurring in large, dense, irregular masses surpassing any changes observed in parathyroid insufficiency. Calcification of the dentate nucleus is usually very marked and, in addition, multiple discrete irregular nodules of calcification are distributed throughout the cerebrum (Fig. 10). The age of the patient and the evidence of disease at or soon after birth should assist in the proper diagnosis.

Two patients with mental deficiency dating from birth exhibited symmetric calcification of the basal ganglia that could not be distinguished from that observed in parathyroid insufficiency (Fig. 11). There was no clinical evidence of parathyroid dysfunction in either case, and the values for the serum calcium and serum phosphorus were normal.

In the course of this study two patients with unilateral calcification of the basal ganglia of minimal degree were observed. In both cases the calcification was disclosed by roentgenograms made routinely for trivial and unrelated symptoms. There was no evidence whatever of neurologic or parathyroid disease in either instance.

COMMENT

It is evident from this study that parathyroid insufficiency is only one of several diseases producing a disturbance of cerebral metabolism which results in the deposition of colloid material in and about the finer cerebral vessels with subsequent calcification. The basal ganglia and dentate

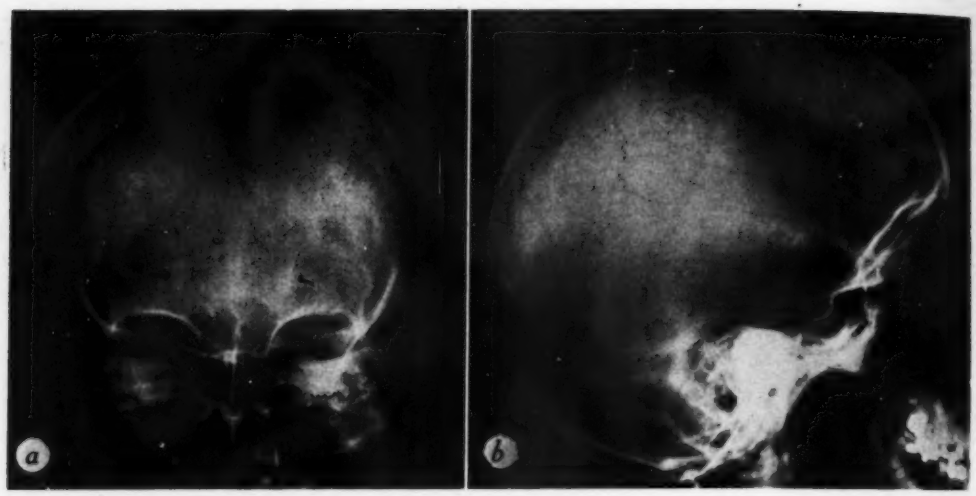

Fig. 11. Roentgenograms revealing symmetrical calcification of the cerebral basal ganglia. Mental deficiency since birth; no clinical evidence of parathyroid insufficiency.

nucleus have long been recognized by pathologists as common sites of predilection for the process. Because of the rarity of spontaneous parathyroid insufficiency and the observance of 11 such cases in which symmetric calcification of the cerebral basal ganglia was observed, I believe the association of the two conditions should be emphasized. It is possible that some cases of marked cerebral calcification associated with mental deterioration and convulsive seizures reported in the literature may have included a parathyroid insufficiency which was not detected. For this reason, all patients with chronic parathyroid insufficiency should have a roentgen examination of the skull. In addition, a determination of the concentration of serum calcium should be made to establish or exclude parathyroid insufficiency in all cases in which roentgenograms show symmetrical calcification of the cerebral basal ganglia. The prompt response to adequate treatment in such cases and the possibility thereby of salvaging an occasional mentally retarded or handicapped person or child should fully justify our endeavors.

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DISCUSSION

Joseph C. Bell, M.D. (Louisville, Ky.): I am certain that we all recognize the very real contribution that Dr. Camp has made this afternoon in the study of some diseases with cerebral manifestations. Many are familiar with the work reported in the literature showing a high incidence of degenerative changes in the basal nuclei in individuals who have died from various causes. We also know that in most of these there was no reason to suppose that there was any correlation between the symptoms presented prior to death and the calcification in the basal nuclei.

My interest in symmetrical cerebral calcification dates from 1928, when I saw the films of a patient with this very characteristic type of cerebral calcification. I was not familiar with the cause or significance of the calcification but was quite certain that it was not in the choroid plexus nor in any type of cerebral tumor. I recognized its real nature and significance only after the work of Dr. Camp and his associates was published. Any one familiar with the characteristics of this particular type of calcification would not mistake it for calcification in a cerebral tumor.

Dr. Camp now makes a contribution of even greater significance. He brings us knowledge of a group, small though it may be, in which there was no hope for recovery in the past but in which recovery, with the chance of leading a useful and more or less normal life, is now not only a possibility but a probability. It would seem to me that this group is larger than appears at present, and I believe that, if our method of examination is that outlined by Dr. Camp, many more than 12 cases will be reported in the next decade.

SUMARIO

La Calcificación Simétrica de los Ganglios Basales del Cerebro en la Insuficiencia Paratiroidea

La insuficiencia paratiroidea es una de varias dolencias que, trastornando el metabolismo cerebral, da por resultado el depósito de sustancias coloideas en los vasos cerebrales más delicados y en la vecindad de los mismos, con calcificación subsiguiente. Los patólogos han reconocido desde hace tiempo que los ganglios basales y el nucleo dentado son asientos predilectos de dicho proceso. En la Clínica Mayo han observado 11 casos de calcificación simétrica de los ganglios de la base del cerebro, asociada a signos clínicos bien definidos de insuficiencia y tetania paratiroideas espontáneas. Dada la rareza de la insuficiencia paratiroidea espontánea y la obervación de estos 11 casos de calcificación simétrica de los ganglios basales, debe recalcarse la asociación de los dos estados y en todo individuo con insuficiencia paratiroidea crónica debe hacerse un examen roentgenológico del cráneo. Además, hay que determinar la concentración del calcio sérico para establecer o excluir la insuficiencia paratiroidea en todo caso en que las radiografías muestren calcificación simétrica de los ganglios de la base del cerebro. La rápida respuesta a una terapéutica adecuada en esos casos y la posibilidad de rescatar así a algun enfermo mentalmente retardado o incapacitado justifican plenamente estos esfuerzos.

Emphysema: An Early Roentgen Sign of Bronchogenic Carcinoma[1]

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THE INCREASING incidence of carcinoma of the lung represents one of the urgent problems facing the medical profession. Whether this increase is real or relative, it is certainly true that the number of cases encountered seems to be greater each year. Surgical procedures have been developed to such a degree that the mortality has been reduced to as low as 5 per cent in one series (3), and five-year survivals after pneumonectomy are now in no sense rare. The importance of early diagnosis of bronchogenic carcinoma, therefore, is self-evident. For purposes of detection of the disease, to give the evidence which will lead to further investigation so that a definitive diagnosis may be made, x-ray examination is, without doubt, the only widely applicable method.

The possibilities and limitations of the roentgen examination in the diagnosis of carcinoma of the bronchus are well known and will not be considered here. We propose rather to describe an early roentgen sign which has been insufficiently stressed, namely, obstructive emphysema.

Although Nils Westermark (6, 7) in 1938 first directed attention to the emphysema caused by the bronchostenosis accompanying bronchial tumors, it is notable and rather remarkable that there are so few references to such cases in the American literature.

Morlock (4) reported a case of carcinoma of the left main bronchus in which there was obstructive emphysema of the entire left lung. X-ray examination showed an enlarged left hilum shadow. Bronchoscopic examination revealed a new growth at the junction of the left upper and left main bronchi.

Cohen (1) reports a case in which atelectasis and obstructive emphysema caused by the same malignant neoplasm were coexistent in the same lung. The tumor was located in the main bronchus so that the orifices of the upper and middle bronchi were completely obstructed, while only a check-valve type of obstruction was produced in the lower bronchus.

Vinson (5) states that emphysema beyond the point of obstruction is rarely present in carcinoma of the bronchus. He does, however, report the case of a twenty-nine-year-old man with carcinoma of the bronchus associated with emphysema.

Westermark (6) divided the effects of bronchostenosis into three separate stages similar to those described by Jackson (2) for foreign bodies. In the first stage there is diminution of aeration as a result of a minimal stenosis. Some impediment to the ingress and egress of air occurs and it is possible that there may be some decreased radiability of the affected lung. Cases in this stage are difficult to detect on x-ray examination and are rarely encountered.

The second stage occurs when the stenosis becomes of higher grade so that a check-valve action takes place. With the diminution of the bronchial lumen occurring during expiration, there is presented a much greater difficulty for the egress of air than for its ingress during inspiration. As a result, a type of relative emphysema affecting the abnormal lung occurs. The lungs may appear almost equal in aeration or in radiability in roentgenograms made during inspiration. In expiration, however, the abnormal lung retains its air while the normal one is deflated, causing a striking difference in their appearance. The

[1] From the Department of Radiology and Physical Therapy, University of Minnesota. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9–10, 1945. Received for publication in June 1947.

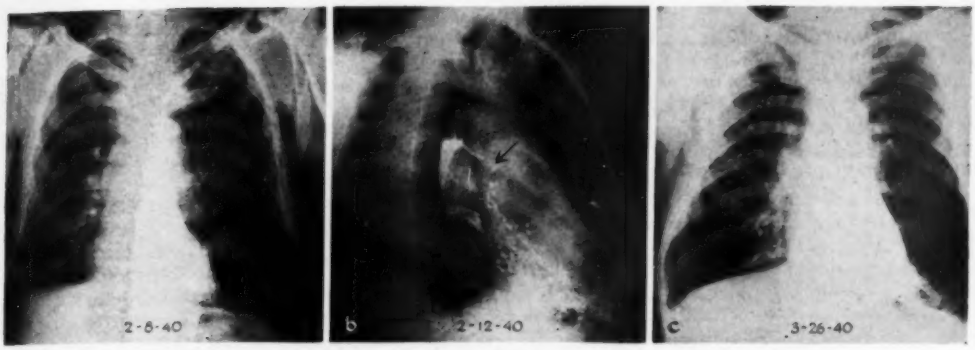

Fig. 1. Case 1: Obstructive emphysema from bronchogenic carcinoma, left lower lobe.
a. Postero-anterior roentgenogram in moderate expiration. Note elevation of right diaphragm and displacement of the heart to the right. The left lung is distinctly more radiable than the right, especially in the lower area. There is a small area of density just at the apex of the heart. Fairly typical obstructive emphysema of the left lower lobe is shown. An inspiratory film at this time appeared normal.
b. Bronchogram. Note the ragged, irregular, partially obstructing lesion in the left main bronchus just distal to the carina (arrow).
c. Postero-anterior roentgenogram in inspiration, seven weeks later. Characteristic emphysema in the left lower area is well shown, indicating an inspiratory as well as expiratory emphysema at this time.

findings are exactly similar to those seen with foreign bodies during the stage of obstructive emphysema. In this situation the diaphragm on the normal side ascends during expiration while on the abnormal side it remains in its inspiratory position. The mediastinum is displaced toward the normal side during expiration as well.

The third stage described by Westermark is that of complete stenosis. At this time the tumor has grown sufficiently, or accumulated sufficient debris or inflammatory products, to occlude the bronchus completely and thus produce the more commonly described atelectasis. The transition from obstructive emphysema to obstructive atelectasis can be observed if cases are followed for a period of time, as indicated in some of the cases reported below.

It should be noted that there occurs a stage in which there is inspiratory as well as expiratory emphysema. Westermark (8) has recently described this stage and, therefore, now refers to four stages of bronchostenosis. Nevertheless, the observation of emphysema is best made during the phase of expiration, because the increased density of the normal lung which occurs during expiration makes the difference in radiability between the two lungs more striking. Such an observation may be made during fluoroscopy, or on roentgenograms if films are made both in the inspiratory and expiratory phases.

It seems possible that the failure to observe this finding more often is the result of the custom of making routine x-ray examination of the chest by means of a single film or stereoscopic films exposed at the end of a deep inspiration. Routine fluoroscopy in all phases of respiration is seldom practised. As will be seen from the case reports in this paper, it is often exceedingly difficult to detect the minor changes which are apparent during inspiration. Films made during expiration would be of the greatest value but are seldom made unless specifically indicated.

CASE 1: A man, aged 58, was admitted to the University Hospital, Feb. 5, 1940. His health had been good until four weeks previously. At that time he began to cough and raised some blood-tinged sputum, as much as 3 ounces being raised daily. There was also some hoarseness during the first week of his illness. He gave a history of periodic elevated temperature ranging from 101 to 103° F. There was no pain, and only moderate dyspnea, but there had been a weight loss of 20 pounds.

Physical examination showed evidences of weight loss. Percussion of the chest showed hyperresonance on the left but with complete absence of breath sounds—the typical signs of trapped air. A few

musical râles were audible in most of the left lung. There was a small node palpable deep in the suprasternal notch. The findings otherwise were essentially negative. Fluoroscopic examination of the chest made at this time showed a typical pendulum motion of the mediastinum, which was in the midline during inspiration and moved distinctly to the right side on expiration. Roentgen examination was made and on expiration (Fig. 1, *a*) showed normal elevation of the right diaphragm, normal decrease in radiability of the right lung, and a shift of the mediastinum to the right. The left lung retained its inspiratory radiability and the left diaphragm remained low. The appearance is characteristic of obstructive emphysema shown only in the expiratory phase. In addition, there was a little mottled density at the very base of the left lung behind the heart.

Bronchography (Fig. 1, *b*) was undertaken, and an irregular, ragged obstructive process in the left main bronchus just beyond the carina was observed, the appearance being characteristic of bronchogenic carcinoma incompletely occluding the left main bronchus. Bronchoscopic examination showed the granular mass nearly completely obstructing the left main bronchus about 1 cm. below the carina. Biopsy was done and microscopic examination gave the typical findings of a bronchogenic carcinoma. Because of the supraclavicular lymph node and evidences of metastasis to the mediastinal lymph nodes, pneumonectomy was not undertaken. Re-examination was done a month later (Fig. 1, *c*) and showed emphysema of the left lower lobe even during inspiration. The patient was treated with radium and x-ray therapy and eventually succumbed to the illness.

Comment: In this case the first sign was an obstructive emphysema of the left lower lobe. It is notable that there was very little evidence of a mass in this case and very slight evidence otherwise on roentgen examination to indicate a carcinoma until the bronchography was undertaken. The small area of increased density at the left base very likely represents beginning atelectasis associated with the emphysema. The roentgenograms illustrate the bronchial obstruction in the stage of expiratory emphysema at first (Fig. 1, *a*). Later a permanent emphysema of the same lobe occurs so that it is clearly visible during inspiration as well (Fig. 1, *c*).

CASE 2: A white male, aged 56, was in good health up to the latter part of 1943, when he began to have frequent colds. In February 1944, he had an episode of pain in the abdomen with vomiting and was hospitalized elsewhere for a period of eight days. The cause of this illness was never definitely determined. Recovery from this episode was apparently complete, and the patient returned to work. During his stay in the hospital a routine roentgenogram of the chest was made and was reported as negative (Fig. 2, *a*).

Two months later the patient had a sudden chill, and was admitted to another hospital. His temperature was high and oxygen was necessary. Sputum examination showed pneumococci Type 1. On roentgen examination of the chest there appeared to be a complete consolidation of the left lung. Under chemotherapy the patient recovered. Follow-up roentgen examination showed some resolution of the pneumonic process in the lower lobe but an atelectasis of the left upper lobe was clearly apparent. There was also, at this time, evidence of increased size of the left hilum. Repeated examination three weeks later showed much the same findings and the mass in the left hilum was more apparent. A tentative diagnosis of bronchogenic carcinoma was made. Owing to the patient's condition, bronchoscopic examination was postponed, not being done until July 17. The diagnosis of bronchogenic carcinoma was then determined positively by means of biopsy and microscopic study.

The patient was admitted to the University Hospital July 23, apparently in good health. Physical examination was entirely negative except for dullness on percussion of the entire left chest and hyperresonance of the right lung. The temperature was normal and there were no other significant findings. The roentgen findings were as shown in Figure 2, *b*. Obvious atelectasis of the left upper lobe of severe grade with a mass in the left hilum is clearly apparent.

On July 31, 1944, Dr. Owen Wangensteen did a total pneumonectomy of the left lung. A group of enlarged mediastinal lymph nodes was found and apparently all were dissected out. The specimen showed a papillary tumor in the left main bronchus extending fully 2 cm. into the upper lobe bronchus but overriding the orifice of the lower lobe bronchus as well. The tumor extended through the wall of the bronchus into a mass of lymph nodes measuring 5 cm. in diameter. Microscopic study indicated that it was a squamous-cell carcinoma of the bronchus with metastasis to the lymph nodes.

The patient has been entirely well since that time and on the last examination, almost three years later, showed no symptoms of recurrence or metastasis.

Comment: In the original films, made during the course of routine examination, a distinct difference in the radiability of the two upper lobes can be made out (Fig. 2, *a*). This film was made in deep inspiration, despite which the emphysema of

the left upper lobe is clearly apparent. At the same time there is seen a moderate enlargement of the left hilum. Observation of these two findings at that time might have lead to a suspicion of the correct diagnosis and further investigation would have been carried on five months earlier than actually was the case.

The transition, in the left upper lobe, from emphysema to atelectasis is well shown in this instance (Fig. 2, *b*). This transition occurred somewhere between February and April of 1944. It appears to have been associated with a secondary infection since the patient actually had a pneumococcus Type 1 pneumonia involving the lower lobe as well as the atelectasis of the upper lobe.

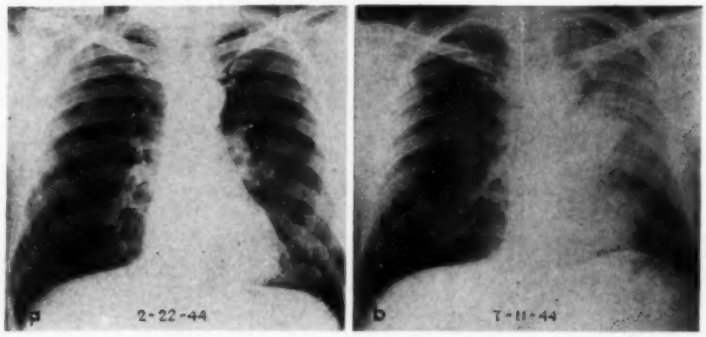

Fig. 2. Case 2: Obstructive emphysema, left upper lobe, from bronchogenic carcinoma.

a. Postero-anterior view Feb. 22, 1944, in deep inspiration. The patient had no specific pulmonary symptoms at this time. There is a distinctly greater radiability in the left upper lobe. The left hilum shadow is increased in size.

b. Re-examination five months later. Characteristic atelectasis of the left upper lobe is now shown. The root shadow on the left is much larger than previously. There is now a compensatory emphysema of the left lower lobe which has come to occupy the apex of the lung and can also be seen as an area of radiability medial to the collapsed upper lobe.

CASE 3: A male, aged 49, was admitted to the University of Minnesota Hospital, March 29, 1945. He had been suffering from a cough since 1920, which came on after an attack of influenza. He had experienced gradual weakness, loss of energy, shortness of breath, and a little pain in the left lower chest. He had lost about 20 pounds in the past five months. On Nov. 20, 1944, the patient went to his family physician for the first time, complaining of pain in the left chest and some cough. At that time a fluoroscopic examination of his chest was made by the physician and no definite abnormal findings were observed. The patient again consulted his physician on Jan. 8, 1945, with somewhat the same complaints; an x-ray examination of the chest was made (Fig. 3, *a*) and interpreted as negative. Shortly after this an episode of fever occurred, and a diagnosis of left lower lobe pneumonia was made on the basis of physical findings and symptoms. The patient responded to chemotherapy and apparently recovered to some degree. On Feb. 12 he experienced another episode of fever, pain in the left chest, cough, and weakness. At that time he was hospitalized elsewhere and a second film of the chest was made. This showed a mass in the left hilum, atelectasis of the lower lobe, and apparently some fluid in the pleural cavity. A tentative diagnosis of bronchogenic carcinoma was then made and the patient was sent to the University Hospital.

On entrance the physical examination showed evidences of considerable weight loss. There were retraction of the left chest on deep inspiration, dullness on percussion, and decreased breath sounds. Planigraphic study was made and a mass in the left lung root as well as obstruction of the left lower bronchus was clearly delineated (Fig. 3, *b*). Bronchoscopic examination March 29, 1945, showed complete obstruction of the left lower lobe bronchus by a mass. Biopsy was done and the microscopic section showed squamous-cell carcinoma. Exploratory surgery was performed April 20, 1945, but the mass was found to be too extensive for removal.

Comment: The original film of the chest made Jan. 8 (Fig. 3, *a*) was considered negative, but on examination it gives clear evidences to indicate the presence of a carcinoma of the lung. There is emphy-

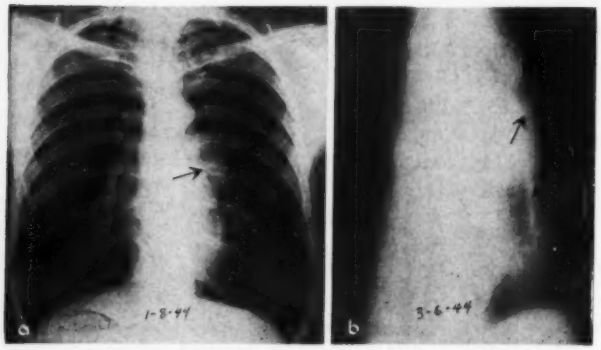

Fig. 3. Case 3: Obstructive emphysema of left lower lobe from bronchogenic carcinoma.

a. Postero-anterior roentgenogram in deep inspiration made Jan. 8, 1944. Increased radiability of the left lower lobe is shown. There is a marked enlargement of the left root shadow (arrow).

b. Planigram made two months later. The mass in the left hilum is more clearly outlined (lower arrow) and the high-grade obstruction of the lower lobe bronchus is also shown (upper arrow).

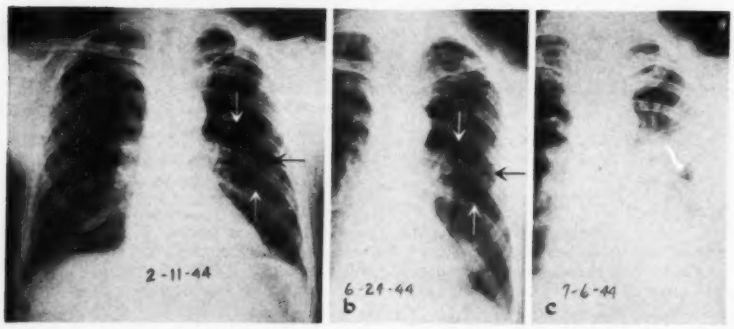

Fig. 4. Case 4: Obstructive emphysema with bronchogenic carcinoma, left.

a. Postero-anterior roentgenogram in inspiration made Feb. 11, 1944, as a routine procedure. The increased radiability in a local segment of the left upper lobe can be faintly made out (arrows). There is a ring-like shadow just lateral to the root of the lung with a moderate area of increased density surrounding it. The latter, no doubt, is due to the compressive atelectasis of the neighboring lung. The left root shadow is somewhat increased in size.

b. Postero-anterior roentgenogram made June 24. The left side only is shown. The area of emphysema is still present (arrows). There is some beginning atelectasis in the lower lobe. The enlarged root shadow is more apparent.

c. Postero-anterior roentgenogram, left side only, made July 6. Atelectasis is now present in the whole lower lobe and involving that portion of the upper lobe which was previously emphysematous. The transition from emphysema to atelectasis is well shown here.

sema of the left lower lobe and a fairly good-sized mass is present in the left hilum. The increased radiability of the left lower lobe is difficult to delineate, since this man had a considerable emphysema of both lungs, related, no doubt, to a long-standing process, present for fifteen years. Films in expiration at that time very likely would have accentuated the increased radiability of the left lung and perhaps given a more distinctive clue to the diagnosis. The change over from emphysema to atelectasis was well delineated in the various roentgenograms. The demonstration of the mass in the mediastinum and the resulting obstruction of the bronchus was effectively made by means of planigraphy (Fig. 3, *b*).

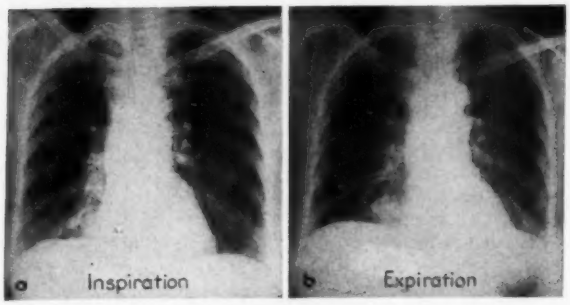

Fig. 5. Case 5: Carcinoma, right lower lobe bronchus, with obstructive emphysema and atelectasis.

a. Postero-anterior roentgenogram in deep inspiration. The lungs, heart, and diaphragm appear approximately normal except for an area of density at the right base in the cardiophrenic angle suggesting a local area of diminished aeration or atelectasis.

b. Postero-anterior roentgenogram in moderate expiration. On the left the diaphragm has ascended in normal fashion, the heart being displaced somewhat to the left side. The distinct difference in radiability between the right and left lungs is now shown, the right lung being more radiable than normal in expiration. The area of atelectasis remains the same. The effect of inspiration and expiration in demonstrating the obstructive emphysema is well shown.

CASE 4: A male, aged 66, was admitted to the Minneapolis General Hospital because of alcoholism and mental deterioration, June 28, 1944. He was suffering from weakness and some epigastric pain. He appeared dehydrated and malnourished. The sedimentation rate was elevated. There was a secondary anemia. The physical and laboratory findings were otherwise negative. A roentgen examination of the chest had been made upon a previous admission on Feb. 11 (Fig. 4, *a*) and thought to be negative. Re-examination of the film however, reveals a local area of increased radiability in the middle portion of the left lung with a slight zone of density around it. A second examination, June 24 (Fig. 4, *b*), revealed a generalized increased radiability of the left lung denoting emphysema. Films were not made in expiration, but the emphysema is visible even in inspiration. About twelve days later a third examination (Fig. 4, *c*) showed a massive atelectasis of the left lower lobe indicating the conversion of a partial obstruction to a complete obstruction. The patient gradually became weaker and died.

Autopsy revealed a bronchogenic carcinoma filling the left main bronchus but obviously originating in the left lower lobe.

Comment: Here again, earlier recognition of the process might have occurred if a film had been made in expiration so that the emphysema would have been more apparent. The rapid change over from emphysema to atelectasis is well demonstrated.

CASE 5: A female, aged 69, was first seen on Dec. 15, 1945. For about twelve months previously she had had a dry, irritating cough with some stridor. At various times she had also experienced hoarseness, dyspnea on exertion, and mild orthopnea. She had lost about 20 pounds during the past year and a half. There were no other symptoms. On physical examination the respiration had a stridorous quality. There were some respiratory lag, dullness and impaired breath and voice sounds on the right side. Wheezing rhonchi were heard over the right lung. Occasionally the cough was productive. On fluoroscopic examination there was found a distinct diminution in the movement of the diaphragm on the right side, which remained low during expiration, while the left diaphragm elevated itself. Clear-cut signs of emphysema in the right upper area could be made out, and some evidences of atelectasis or decreased aeration in the right lower. Films confirmed this finding (Fig. 5, *a* and 5, *b*). Planigrams were then made and a defect in the right main bronchus arising apparently 2 cm. from the carina could be made out. This appeared to occlude the lower lobe bronchus almost completely but only partially obstructed the upper lobe. The possibility of a benign tumor was then considered. Bronchoscopy was done Dec. 21, and bronchography at the same time. An ulcerating lesion could be made out bronchoscopically at the carina, extending down the right main bronchus. The orifices of the right upper and middle lobe bronchi appeared open, although the ulceration extended down toward these areas. Granulomatous lesions, however, reduced the lumen of the right main bronchus to approximately one-half its norm. These granulomatous

lesions extended down into the orifice of the lower lobe bronchus and almost completely occluded it. There was, however, still some opening in the umen of the right lower lobe bronchus. On bronchography a defect in the lower lobe bronchus could be clearly made out just at its bifurcation. There seemed to be some compression of the lumen of the upper lobe bronchus and the main stem bronchus, apparently from an extrinsic mass. Biopsy of the granulomatous material showed a typical bronchogenic carcinoma of the small-cell type.

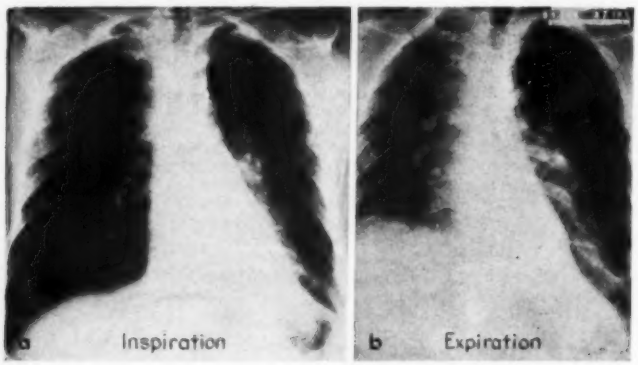

Fig. 6. Carcinoma of the left main bronchus with atelectasis of lower lobe and emphysema of upper lobe. Case of Dr. T. M. Berman, Miami Beach, Florida.

a. Anteroposterior roentgenogram, supine position, in deep inspiration. Increased density of the heart on the left side and density extending beyond it indicate an atelectasis of the lower lobe, as well as a tumor in the lung root. There is a moderate increase in radiability in the left upper lobe, the difference between the two lungs being apparent even during inspiration. Note the mass of enlarged lymph nodes in the right peritracheal area.

b. Anteroposterior roentgenogram, supine position, in deep expiration. The diaphragm has ascended on the right. The radiability of the right lung has diminished, as is normal in expiration. The heart is displaced sharply to the right side. The atelectatic left lower lobe is exposed by the displacement of the heart. The much greater radiability of the left upper lobe as compared to the right is clearly apparent, indicating the obstructive emphysema of the upper lobe, which was due to partial obstruction of the left upper lobe bronchus. The atelectasis of the lower lobe was due to complete obstruction of this bronchus by the same carcinoma. The effect of inspiration and expiration in demonstrating the findings in the lungs is well brought out.

Because the ulceration extended up into the carina, surgery was not done. Some radiation was given, with apparently some relief temporarily. An acute episode later developed, possibly related to the irradiation. Since then the patient has been lost sight of.

Comment: In this case the x-ray findings are relatively minimal except for the obstructive emphysema of the right lung, which is combined with some beginning atelectasis of the lower lobe. Thus we have the partial obstruction of the right main bronchus producing emphysema, with almost complete obstruction of the right lower lobe bronchus producing marked decrease in aeration. The findings were first observed during routine fluoroscopy of the chest, although the symptoms pointed somewhat in this direction.

Two other cases should be added to this category although they will not be described in detail. One of the patients is a miner who was being examined annually because of the possibility of silicosis. On the last routine examination, made a little over a year before his entrance into the University Hospital, restudy of the films showed a distinct emphysema of the right upper lobe. This film was made in deep inspiration and the findings are so slight that it is not possible to reproduce them, but we were satisfied on independent examination that actual emphysema existed

at that time. When the patient came to the hospital, evidences of atelectasis were already present and a definite obstructive tumor of the right upper lobe bronchus was made out both by bronchography and planigraphy. This proved to be a bronchogenic carcinoma.

A final case likewise will not be described in detail. We are indebted to Dr. T. M. Berman of Miami Beach, Florida, for the privilege of reporting it. The patient was proved to have bronchogenic carcinoma on the left side, the tumor producing emphysema and atelectasis in the same lung simultaneously. The inspiratory roentgenogram (Fig. 6, *a*) shows extensive density in the left lower lobe, representing an atelectasis of considerable degree. The aeration of the left lung above this and of the right lung appears almost equal; there may perhaps be a slight degree of increased radiability on the left side. A roentgenogram in expiration (Fig. 6, *b*), however, is very illuminating. While the atelectasis in the lower lobe remains about the same, the upper lobe appears far more radiable than the opposite lung. The mediastinum has moved well over to the right side and the right diaphragm is elevated. The left remains the same. This is typical of an obstructive emphysema and in this case was due to a tumor which completely occluded the lower lobe bronchus and protruded sufficiently into the lumen of the upper lobe bronchus to produce a partial obstruction with obstructive emphysema in the phase of expiration.

The value of the roentgenogram in expiration is again delineated in these two cases. In the first the diagnosis might have been suspected a year before it was made if an expiratory film had been made. In the last case the striking difference in the appearance of the emphysematous lobe in inspiration and expiration is well brought out (Fig. 6).

SUMMARY AND CONCLUSIONS

Obstructive emphysema is an early sign of bronchogenic carcinoma resulting from partial obstruction of a bronchus by the tumor.

It is best demonstrated by roentgenograms or fluoroscopic examination made during expiration. The transition from emphysema to atelectasis as the tumor grows and completely obstructs the bronchus may be readily determined by repeated roentgen examination.

Five cases are reported in detail and two partially to illustrate the importance of these observations.

Patients suspected of bronchogenic carcinoma but without frank roentgen findings should always be examined in expiration as well as inspiration.

Careful study should be given to minor differences in radiability of the two lungs to determine whether obstructive emphysema is present. Such a finding should lead to further investigation by bronchography, planigraphy, and bronchoscopy.

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SUMARIO

Enfisema: Signo Roentgenológico Temprano del Carcinoma Broncógeno

El enfisema obstructivo constituye un signo temprano del carcinoma broncógeno, ocasionado por la obstrucción parcial de un bronquio por el tumor. Se observa mejor en los roentgenogramas o exámenes roentgenoscópicos ejecutados durante la expiración. Por medio de exámenes roentgenológicos repetidos puede determinarse fácilmente la transición del enfisema a la atelectasia a medida que el tumor crece y obstruye completamente el bronquio. Descríbense cinco casos minuciosamente y dos parcialmente para demostrar la importancia de estas observaciones.

A los pacientes en que se sospecha carcinoma broncógeno y los hallazgos radiológicos no son terminantes, debe examinárseles siempre durante la expiración así como la inspiración. A fin de determinar si existe enfisema obstructivo, hay que estudiar cuidadosamente las pequeñas diferencias en radiabilidad de los dos pulmones. Un hallazgo de esa naturaleza debe instigar nuevas investigaciones broncográficas, planigráficas, y broncoscópicas.

Roentgenologic Study of the Small Intestine

I. Neoplastic and Inflammatory Diseases[1]

FRED J. HODGES, M.D., R. WAYNE RUNDLES, M.D.[2], and JOSEPH HANELIN, M.D.

No physician can long engage in the practice of medicine without becoming impressed by the fact that complaints variously related to the alimentary tract are commonplace and diverse. More often than not, when radiologic consultation is arranged, no convincing explanation for the patient's symptoms is manifest at the fluoroscope or in supplementary roentgenograms. It has been the uniform experience of many radiologic groups who examine large numbers of persons each year, in search of demonstrable signs of gastro-intestinal disease, that dependable x-ray evidence of significant abnormality is to be expected in no more than 25 to 30 per cent of all patients whose digestive complaints have brought them to the radiologist for diagnostic consultation. In most of the cases where no abnormality can be found, the presenting symptoms are of such a nature that it is sufficient for the radiologic examination merely to exclude unlikely lesions. In other cases, however, there may be persistent, annoying, and even incapacitating symptoms arising from abnormalities which routine procedures may fail to uncover. Negative reports from the roentgenologist often result in lost opportunities for therapy. Harm may follow the all too frequent impeachment of the patient's psychiatric integrity.

Gross pathologic lesions of the esophagus, the stomach, and the colon are recognizable with a high degree of accuracy by able roentgenologists with or without the advantage of leading clinical information. In other words, if digestive tract symptoms are produced by such lesions as peptic ulcer, gastric or colonic neoplasms, ulcerative colitis, and the like, recognition and accurate diagnosis of the underlying cause of the patient's complaints may be anticipated with reasonable confidence on the basis of x-ray findings. Disorders of the small intestine, on the other hand, producing motor or absorptive disturbances, will be as consistently overlooked unless clinical acumen is exercised and diagnostic efforts are properly directed.

Ordinarily employed procedures in the roentgenologic search for alimentary tract disease are centered to an overwhelming degree upon the proximal three feet and the distal five feet of the tube, those portions which experience has taught harbor the great bulk of x-ray recognizable abnormalities. By and large, the longest portion of the gastro-intestinal tract, beginning at about the ligament of Treitz and extending to a point within 12 to 18 inches of the cecal junction, is scrutinized, if at all, in a most desultory fashion by most of us who are engaged in gastro-intestinal diagnosis. It is necessary to bear in mind that, despite its many and spectacular achievements as a demonstrator of disease processes, the x-ray approach to diagnosis is by no means omnipotent. Dependent, as he most certainly is, on the observation of form and motion of the gut wall, the roentgenologist—and the physicians who call him in consultation—must remember that a great many deviations from normal can exist which do not produce roentgenologically recognizable signs. It is thoroughly possible and entirely probable, on the other hand, that mild and grave disorders not now recognized can be readily discovered by increasing the scope and versatility of gastro-intestinal x-ray diagnostic procedures.

[1] From the Departments of Roentgenology and Internal Medicine, University Hospital, University of Michigan, Ann Arbor. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9–10, 1945. Submitted for publication in April 1947.

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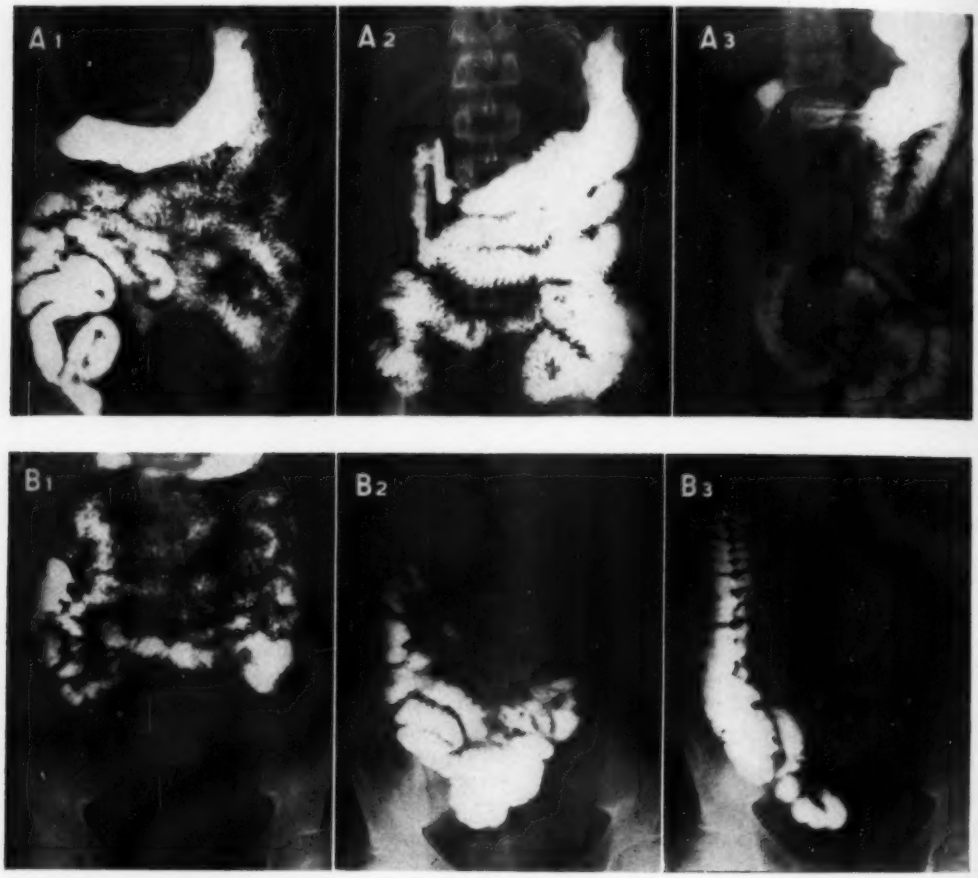

Fig. 1. Normal small bowel behavior

A-1, 2, 3. Typically normal appearance of upper small intestine immediately after barium feeding in three different patients.

B-1, 2, 3. Normal behavior of small intestine as observed in the same patient immediately, two and a half, and five hours after barium ingestion.

The technical steps employed in the examination of the gastro-intestinal tract vary widely in the matter of detail as practised in various clinics, offices, and hospitals throughout this country. In general, however, the great majority of all x-ray examinations of the intestinal tract involve one or the other or both of two basic procedures. The first of these involves the administration of a suspension of inert opaque salts by mouth, whereas the second depends upon the injection of a similar opaque mass per rectum. The proportionate emphasis upon fluoroscopy and radiography in making observations upon the gut when so prepared, as well as the time and the distance of travel over which the progress of injected material is followed, differs greatly in the hands of various examiners (8, 34).

Generally speaking, the major extent of the small intestine receives scant attention in the course of most gastro-intestinal examinations. Oftentimes more or less perfunctory filming at frequent and arbitrary intervals is followed almost religiously with major attention on the possible role of the appendix in producing obscure symptoms. Not until relatively recent years have radiologists made serious attempts to glean

significant diagnostic evidence regarding the status of the small intestine from the jejunum to the low ileum. One method which has gained some favor, the small bowel enema, has been advocated by Schatzki (29). This method, undoubtedly useful in some situations, is not without its practical disadvantages. Cole (5), Pendergrass *et al.* (26), Golden (8, 9, 10, 11, 20), Mackie, *et al.* (22, 23, 24), Snell and Camp (31), to mention but a few names, have been pioneers in this country in the matter of directing roentgenologic attention to the small intestine. As the result of the interest and industry of these workers, much has been learned regarding the anatomical and physiological features of the small intestine as demonstrable by x-ray methods, and as a logical consequence the general fund of knowledge regarding disease states involving the small bowel has been considerably expanded. Alterations in the behavior of the small intestine, as well as often overlooked details of appearance, have been described following the chemical and physical alteration of the contrast material used (26). These observations, if they have done nothing else, have called attention to the fact that the small intestine is capable of reflecting responses to environment and stimulation. It seems logical that, with the accumulation of more experience in this field, roentgenologists will one day come to recognize with confidence many other factors which can visibly alter the form and behavior of the small intestine.

Excursions into this relatively new field of roentgenological interest have stimulated renewed interest in the histology, the neuro-anatomy, and the physiology of the intestine (11). Much attention is being paid to the intimate pattern imparted to opaque material within the lumen by the folds of the mucosal lining. While the nervous and muscular mechanisms responsible for small bowel behavior are as yet insufficiently well established to permit uniformity of opinion by all interested investigators, there is good reason to believe that the mucosal pattern is dependent upon the activity of the muscularis mucosae, which is capable of operating independently of the circular and longitudinal muscular coats. It can be shown, for example, that the direction of mucosal folds is independent of lumen caliber (11) and that the direction of folds may change with great rapidity from transverse to longitudinal in immediately neighboring segments of gut. Several examples of normal small bowel appearance are illustrated in Figure 1, notable among these features being the sharp, delicate fold imprints seen in the duodenum and upper jejunum, the uniformity of lumen width, and the transition to a blunter or coarser mucosal pattern when the barium column reaches the ileum. It is to be remembered that range of variability in the matter of small bowel appearance is considerable. In Figure 2, profound changes in the appearance of mucosal pattern are shown under various conditions. In the present state of our knowledge at least, it does not seem wise to attach too much significance to minor or controversial alterations in appearance unless supported by other clear-cut evidence of disease.

Grosser methods of evaluating the status of the small intestine relate to over-all accomplishment as measured in broad terms of transit time, as well as emptying time of the stomach (which is capable of materially affecting the time of transit through the small bowel), absolute and relative caliber dimensions, and the scattering or breaking up of the opaque column into bowel segments of varying length and configuration. The term "puddling" enjoys rather wide usage in describing an appearance, considered to be abnormal, which is characterized by somewhat widely separated deposits of barium in isolated segments of small bowel.

When the sole evidence of gastro-intestinal abnormality in a given instance is found to depend upon alterations in behavior of alimentary tract structures, the disturbance may fairly be spoken of as functional without implying that it is psychogenic. It is our habit to disregard or

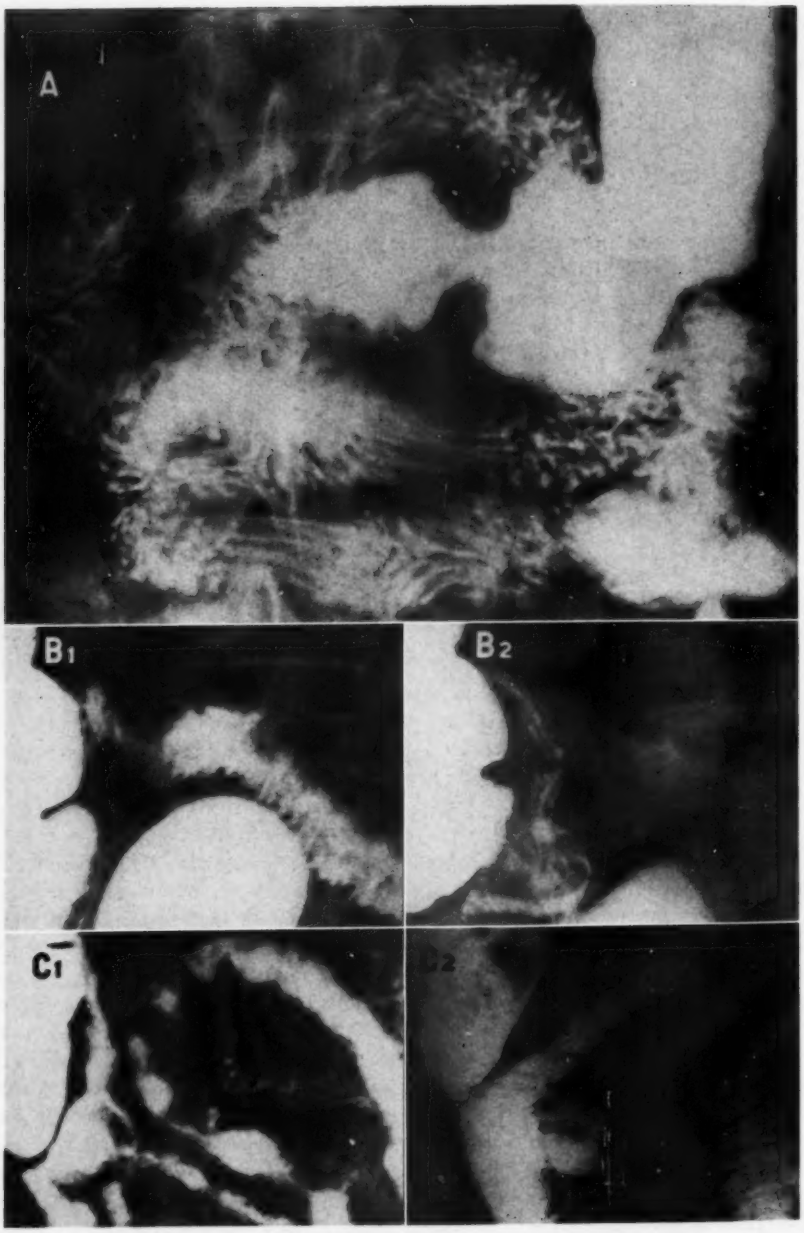

Fig. 2. Normal small bowel behavior

A. Characteristic upper small bowel mucosal pattern. Note changeability of mucosal folds—horizontal and longitudinal folds seen in immediately adjacent segments of gut.

B-1, 2. Normally changeable appearance of mucosal pattern in terminal ileum as seen following barium enema, before and after voluntary evacuation.

C-1, 2. Normal variability of terminal small bowel appearance as seen five hours after barium ingestion, and on another occasion following barium enema.

minimize roentgen signs of alimentary tract dysfunction when they are over-shadowed by palpable evidences of intrinsic organic disease. More or less by common consent, the term "functional disorder," at least when the condition is discovered on the basis of x-ray findings, implies that the reasons for faulty function are not immediately apparent roentgenographically. Some organic lesions which may not be recognized with conviction in their own right are apprehended on the basis of fairly well localized and striking changes in function. It is only when we are at a loss for objective evidence which points directly to a morphologic lesion that we fall back upon the word "functional" in our roentgenologic jargon.

METHOD OF STUDY

Many of the technics which have been devised to subject the small intestine to exhaustive scrutiny are so time-consuming as to be prohibitive when it is desirable to examine large groups of patients. Without wishing to be critical of the diagnostic merits of such procedures, one might well point out that less exacting technics may be used for screening purposes to locate likely candidates for more exhaustive studies. One such screening method enjoys the advantage of great simplicity and facility of application while yielding a considerable amount of valuable information. This screening method virtually eliminates fluoroscopy, which makes the greatest time demand, by restricting the latter to the time of barium feeding and the few moments required to observe the progress of the meal well into the jejunum. In addition to this brief fluoroscopic observation, the method employs full abdomen filming in the form of single exposures immediately at the completion of the fluoroscopic examination, and repeated at a few specified intervals thereafter. Intervals of one hour, two and a half hours, and five hours have been found to provide a great deal of information regarding the status of the small bowel. Figure 1 (B-1, 2, 3) represents films made immediately and at two and one half and five hours after feeding in the case of one of 12 healthy individuals studied. It is not to be understood that the particular distribution of barium shown in this illustration is dependable within narrow limits as an expression of the normal. Every radiologist of experience is well aware that variability rather than constancy is the rule in all forms of gastrointestinal radiography. Within limits, however, one is entitled to expect that a normal stomach will be virtually empty at two and one half hours and that the barium which has passed the pylorus will have progressed far into the ileum. He may further expect that at five hours filling of the right colon will be well advanced, and that barium remaining in the small bowel will be confined to the terminal portion of the ileum. While exceptions to the rule are numerous, it is common to observe that all of the barium administered will be found below the level of the umbilicus and to the right of the mid-line at the five-hour interval. Organic lesions which obstruct the small bowel lumen at any level will profoundly disturb this time-table, and abnormalities, whatever their nature, which disrupt the orderly mechanism of propagation of the meal will be apprehended. Organic lesions or functional disturbances capable of modifying the consistency of the gut wall or the continuity of muscular activity in any of the coats will be very apt to come to light in either or both of the standardized exposures at two and one half and five hours.

This plan of roentgen examination was used in the study of more than 100 patients selected on the basis of having symptoms thought to represent small bowel dysfunction. These symptoms comprised, in general, gross abnormalities of bowel habit, chronic diarrhea or acute refractory constipation not due to demonstrable colonic disease, abdominal pain of colicky nature unrelated to bowel movements, gaseous distention, borborygmi, and severe anorexia sometimes with nausea and vomiting. A few patients had had in addition repeated unexplained hemorrhages from the

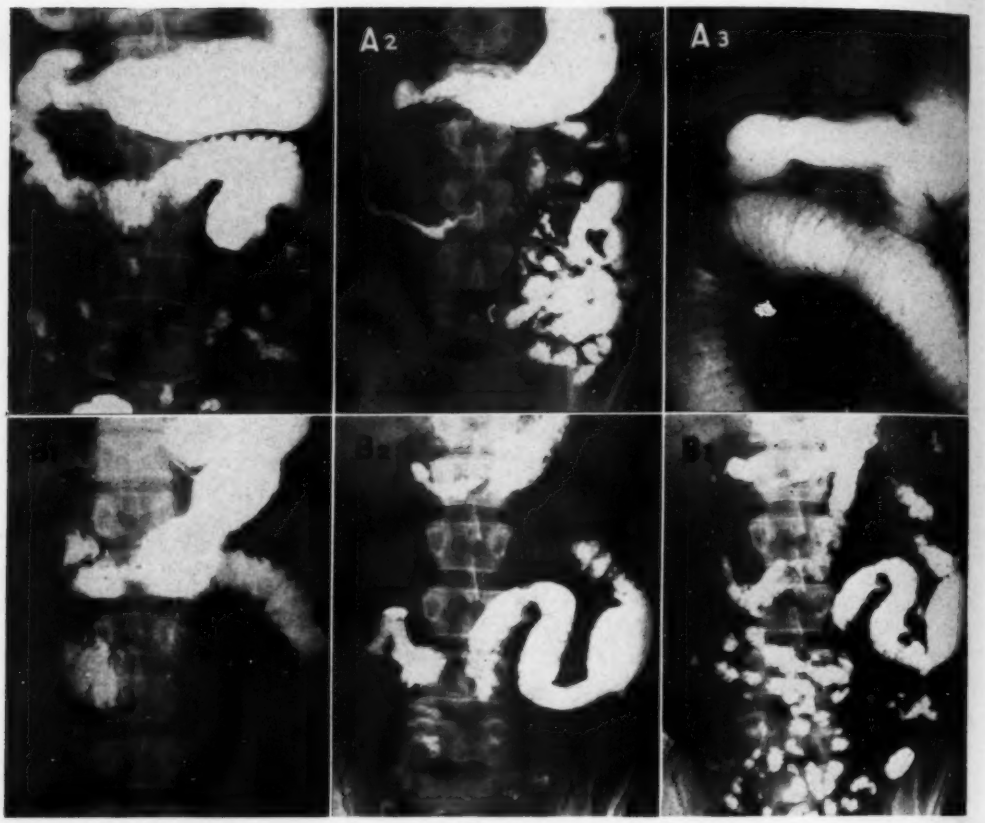

Fig. 3. Organic lesions involving small bowel

A. 1. Case 1: Primary adenocarcinoma of jejunum producing high grade obstruction. 2. Case 2: Lymphoblastoma involving the duodenum. 3. Case 3: Primary carcinoma low in the jejunum, producing generalized distention of prox.mal small bowel. Note preservation of distinct mucosal folds.

B-1, 2, 3. Case 4: Regional ileitis involving a considerable segment of jejunum. Note delayed emptying of smoothly margined convoluted loop of bowel in mid abdomen which remains filled two and a half and five hours after barium feeding.

intestinal tract or chronic anemia due to blood loss or absorptive abnormality. The final diagnoses included chronic ileojejunitis, severe vitamin B deficiency, neuropathies involving the autonomic nerves, and alteration in appearance following sympathectomy and other surgical procedures.

Once roentgenologic findings indicative of structural abnormality or functional misbehavior of the small intestine are uncovered, the difficult problem of interpretation arises. Many diseases and processes have to be considered in differential diagnosis, and final conclusions are seldom possible from roentgen study alone. Neoplasms of the small intestine, which are fortunately rare, give rise to characteristic signs only after the lumen has been considerably deformed, often to the point of obstruction (35). Chronic inflammatory disease of the small intestine, occurring with hepatitis (11, 12, 21, 25), ulcerative colitis (24), and sometimes in a form progressing to regional cicatrization (4, 6, 7, 17, 18, 30, 32, 33), may or may not be distinguishable roentgenologically from non-inflammatory lesions. The function and appearance of the gut may be altered by edema consequent to portal vein hypertension or obstruction, low serum proteins (1, 2, 11), severe anemia (16), hookworm

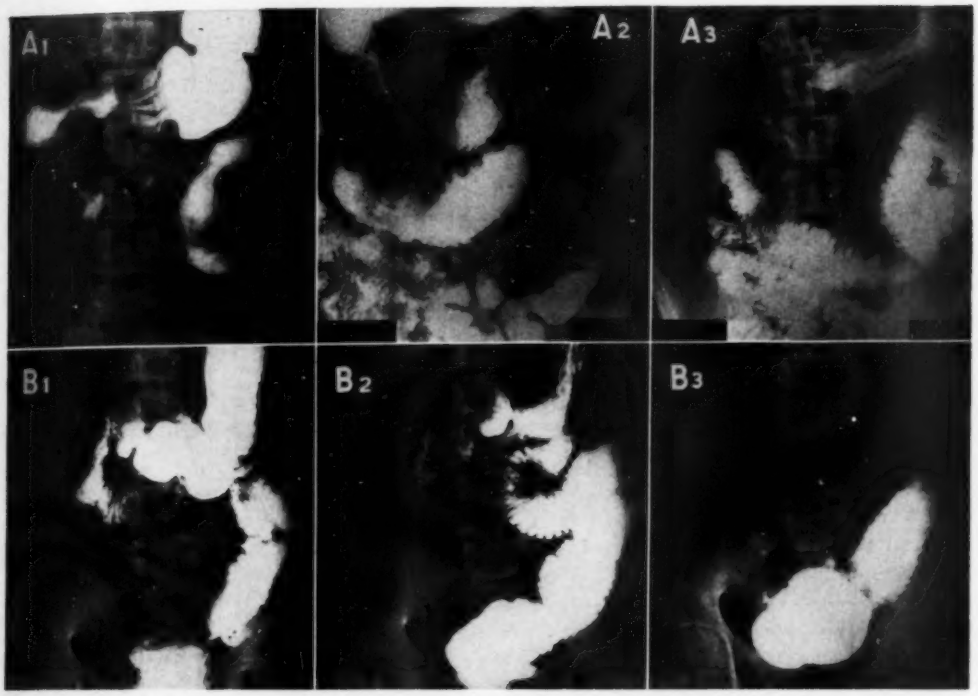

Fig. 4. Organic lesions involving small bowel: extensive regional enteritis involving jejunum
A. Case 5: Note the profound deformity of a loop of jejunum to the left immediately after barium feeding (A-1) with widening of lumen and loss of normal mucosal markings. At two and a half hours (A-2), a horizontal segment of jejunum at a lower level can also be seen in which the lumen is broadened and the mucosal pattern is coarse and irregular. Twenty months later (A-3) the only residual signs of previous inflammatory disease are slight widening of the lumen and slight coarsening and irregularity of mucosal folds.
B-1, 2, 3. Case 6: Regional enteritis 3 feet distal to the duodenal jejunal junction, producing complete obstruction as shown immediately, two and a half, and five hours after barium feeding.

infestation (15, 19), in Henoch's purpura (36), and perhaps in allergic conditions with urticaria (11). A generalized disease of the connective tissue of the body, scleroderma, may involve the intestinal wall (13). Gross abnormalities of the intestinal tract have been attributed to diseases of nutrition, vitamin B deficiency, and sprue (10, 20, 22). It is often a question as to whether the nutritional deficiencies are primary or actually the result of another disease (3). Finally, intestinal dysfunction has been attributed to disturbances of the intrinsic and extrinsic autonomic nerves (11, 27, 28). Too little evidence has been accumulated regarding all of these factors to allow more than a rough estimate of the expected roentgen abnormalities in interpreting a given case.

In postulating the existence of neoplastic or inflammatory lesions of the small intestine the roentgenologist in general depends upon fixed or relatively fixed deformities of the gut lumen, displacement of the gut segments, and signs of luminal obstruction. Several small bowel lesions of proved identity are illustrated in Figure 3. In the first of these (A-1) an annular adenocarcinoma in the proximal jejunum had produced high-grade luminal obstruction with consequent dilatation proximal to the obstruction site. A lymphosarcoma involving the major portion of the duodenum (A-2) was recognizable as an organic lesion on the basis of profound and extensive deformity of the gut segment as well as displacement of the affected and uninvolved gut loops. Again generalized distention,

without obliteration of normal mucosal folds, throughout a considerable length of small bowel proximal to an obstruction point led to the correct diagnosis of a primary carcinoma of the jejunum 3 feet beyond the ligament of Treitz (Fig. 3, A-3). In the case of a fourth patient (Fig. 3, B-1, 2, 3), more extensive organic disease involving several inches of jejunum in mid abdomen, slightly to the left of the midline, obliterated normal mucosal markings, rendered the affected segment of gut relatively non-pliable, and partially obstructed the transit of barium. In all of these situations, localized organic small bowel disease was reported with confidence on the basis of objective evidence.

The situation shown in Figure 4 (A-1, 2, 3) represents chronic regional enteritis, again involving the jejunum. This patient was examined during a period when acute symptoms were present and eighteen months later during quiescence. Here again the roentgenologic signs of intrinsic deformity, as well as partial obstruction to the transit of barium, were clear-cut and were accepted as reliable evidences of organic disease. The fact that spontaneous recovery did not occur without some telltale residual evidences of disease is nicely shown in A-3, in which slight residual widening of lumen and a slight coarsening of mucosal pattern were seen to persist. Interpretation of the disease process on the basis of the second roentgen study alone would have been difficult. Case 6, illustrated in Figure 4 (B-1, 2, 3), is an example of regional enteritis in which the organic deformity of the affected segment cannot be seen because associated obstruction is profound. In this instance the presence of the lesion was postulated on the basis of obstruction and its non-neoplastic character was assumed because the clean-cut overhanging edges of gut so typical of annular neoplasm were not to be seen.

Additional examples of organic small bowel lesions which advertised their presence by producing demonstrable roentgenologic signs which may be considered to be diagnostic are shown in Figure 5. Persistent irregular deformity and associated displacement of the extreme terminal ileum shown in A-1 represent the effect produced upon neighboring small bowel by an appendiceal abscess. Loss of all mucosal markings, irregularity of lumen width, and rigidity of walls as proved by multiple exposures mark A-2 as an example of ileocolitis of the ulcerative type. What may be considered an almost classical deformity of ileocecal tuberculosis is shown in A-3.

Case 10, shown in Figure 5 (B-1, 2), represents disease which involves a larger segment of the small intestine. Here delayed transit, variability of lumen width, and widespread modification of mucosal pattern were produced by extensive regional enteritis. A roentgenogram of the surgical specimen from this case is shown in B-3. This specimen is interesting because it shows, at the lower margin of the illustration, multiple zones of contracture of the lumen ending abruptly at a point where the gut lumen has been expanded as the result of the over-all obstruction. It is interesting to ponder whether long-standing regional ileitis produces "up-stream" changes simply by obstruction or whether the inflammation has actually been more extensive and led to scarring with damage of the muscles and nerves of the gut wall.

To discover such striking abnormalities with any degree of frequency among patients referred for roentgen study of the small intestine is certainly not to be expected. Among patients carefully selected for such study obviously disturbed function will be found in less than one-half. In relatively few of these will the roentgen findings justify any presumption as to the nature of the underlying disease. In 11 cases, which have been neither abstracted nor illustrated here, no entirely convincing roentgen sign could be found to indicate that the disorder was certainly of inflammatory origin. In every instance, however, there was overwhelming clinical or surgical evidence of chronic nonobstructive ileojejunitis. In 2 there was in addition associated chronic ulcerative colitis. The roentgenologist can only re-

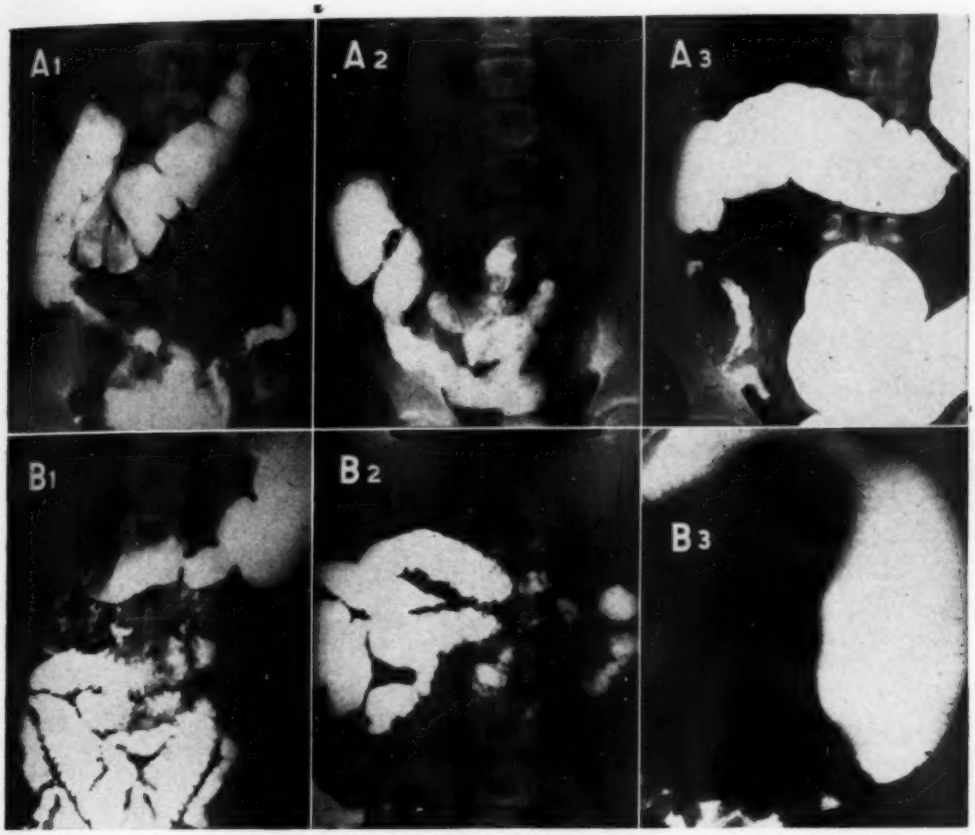

Fig. 5. Organic lesions involving small bowel

A-1. Case 7: Narrowing, irregularity of lumen, slight upward displacement, and appearance of rigidity involving the terminal ileum produced by periappendiceal abscess.

A-2. Case 8: Segmental narrowing and dilatation of terminal small bowel, tapered ileocecal junction, and contracted cecal tip in a patient with proved ulcerative ileocolitis.

A-3. Case 9: Characteristic profound deformity of the extreme tip of the cecum, narrowing of the ileocecal junction, and intense narrowing of the terminal ileum, with loss of all mucosal pattern, in a patient with ileocecal tuberculosis.

B-1, 2. Case 10: These exposures immediately and five hours after barium feeding show extensive disturbance of the mucosal pattern and great delay in transit in the case of a patient with extensive regional enteritis involving the lower ileum.

B-3. Case 10: Roentgenogram of operative specimen obtained ten months later. Note greatly dilated segment distal to smoothly narrowed portion and multiple strictures in the generally contracted distal segment at the lower left corner of the illustration.

port in such instances that there is reliable evidence of "dysfunction" and allow clinical or pathologic studies to establish the etiology.

Roentgenograms from the records of two patients are presented for the purpose of illustrating to what profound degree the ordinary functional activities of the intestinal tract can be disrupted. In spite of all possible study, the cause of the difficulty in these cases could not be ascertained. In Figure 6 are reproduced selected roentgenograms of a patient (Case 11) whose clinical situation was replete with striking evidence of generalized disturbance of the intestinal neuromusculature. Even casual inspection of the illustrative material indicates that the entire alimentary tract from the esophagus to the pelvic colon is behaving in a most peculiar manner. Cardiospasm, shown in the first illustration (A-1), was the initial reason for roentgen examina-

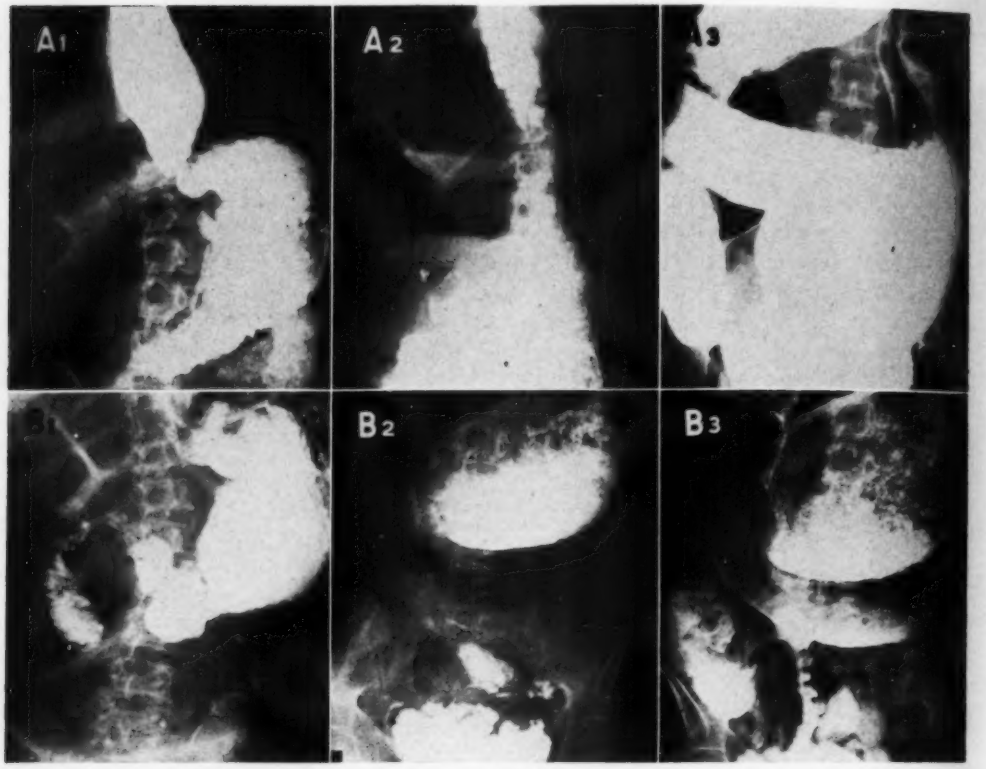

Fig. 6. Functional small bowel disturbance

A-1, 2, 3. Case 11: Cardiospasm, greatly distended small bowel and colon (patient standing), and the colon following barium enema showing greatly increased capacity, generalized loss of tone, and absence of typical haustral markings in the transverse portion.

B-1, 2, 3. Case 11: Exposures immediately, five, and twenty-four hours after barium feeding indicate the degree of delayed gastric emptying encountered in this patient, as well as profound delay in small bowel transit time and widespread loss of tone.

tion. That this was a minor expression of the profound disturbance affecting the entire alimentary tube is well shown in the remainder of the illustrations (A-2, 3; B-1, 2, 3). There seems to be ample evidence to indicate that the complex and elaborate nervous and muscular mechanism which controls and co-ordinates the motor function in the intestine was extensively disrupted.

Case 12 (Figs. 7 and 8) in this series shows an exceptionally severe disturbance in the function of the entire gastro-intestinal tract similar to Case 11. The patient was studied and treated intensively for a period of eight months. At no time was there clinical evidence of specific vitamin deficiency, anemia, or neurologic disease involving the cerebral, spinal, or autonomic nerves. There was no significant response to therapy and death eventually occurred, as a result of failure of the motor and absorptive functions of the intestinal tract. At necropsy there was extreme atrophy of all the organs, malnutrition, and muscular atrophy with diffuse fibrosis of the entire intestinal tract. Special examination of the central and peripheral nervous system, while unfortunately limited to small portions of these structures, nevertheless demonstrated profound change. Marchi preparations of the spinal cord and sciatic nerve showed advanced myelin degeneration (Fig. 7, B-3, Fig. 8, A). The myelin

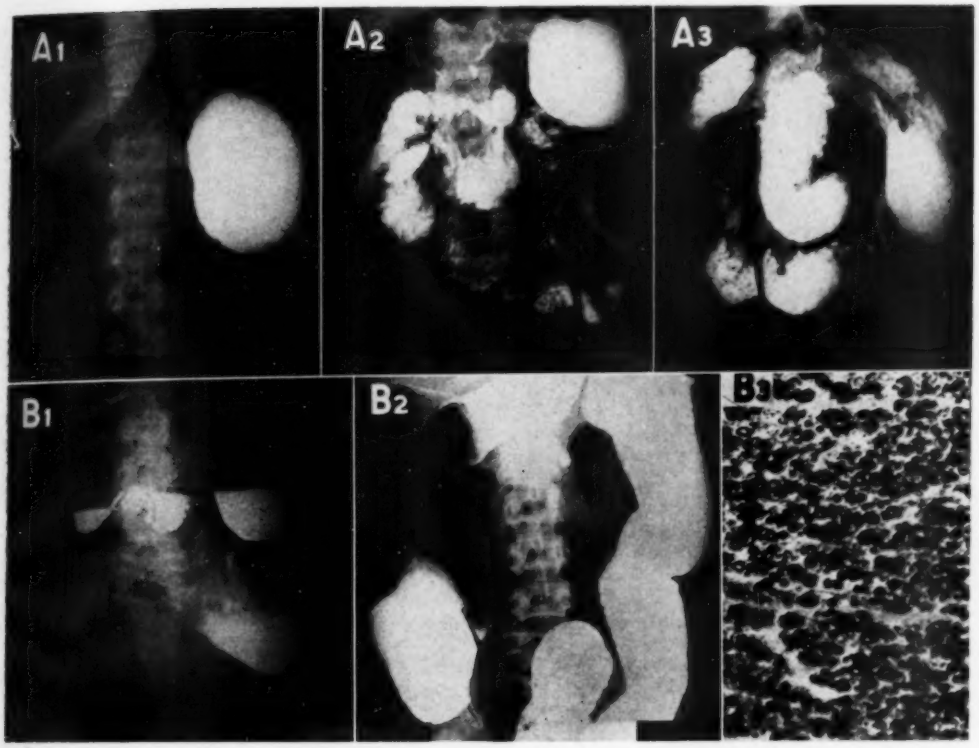

Fig. 7. Functional small bowel disturbance

A-1, 2, 3. Case 12: Appearance of small bowel and stomach immediately and at two and a half and five hours after barium feeding. Observe tremendously delayed small bowel transit time, delayed gastric emptying, and gas accumulation in small bowel and colon.

B-1. Case 12: Film made in standing position, same patient, five hours after barium feeding, six weeks after initial examination. B-2. Voluminous atonic colon, same patient, four months later. B-3. High-power photomicrograph showing advanced degeneration of the white matter of the spinal cord with edematous, swollen, and disintegrating myelin sheaths stained black with osmic acid, Marchi technic. (Apochromat Bausch and Lomb 8.3 mm.; ampliplan low.)

appeared swollen and broken into numerous fragments which stained jet black with osmic acid. The intramural nervous system of the intestinal tract could only be examined by ordinary staining methods. The ganglia of Auerbach's plexus, as shown in a van Gieson preparation (Fig. 8, B) were swollen, their neurones were reduced in number, and the perisomatic glia was proliferated. Nerve fibers connecting ganglia exhibited degeneration comparable in severity to that of the sciatic nerve. Because of the limited amount of nervous material studied, interpretation of the histopathologic findings must be made with reserve. It is evident, however, that both the central and peripheral nervous system suffered damage to a degree which was no longer compatible with life. The profound functional disturbance of the intestinal tract as demonstrated roentgenographically appears to be intimately related to the intramural nervous system changes. A satisfactory explanation of the whole course of this patient's illness is not forthcoming. The neurologic changes are particularly engrossing and challenging. At this time one cannot be certain whether they were primary in origin, or secondary to some systemic disorder. Their severity, however, underlines their significance. Intensive study of the peripheral and central

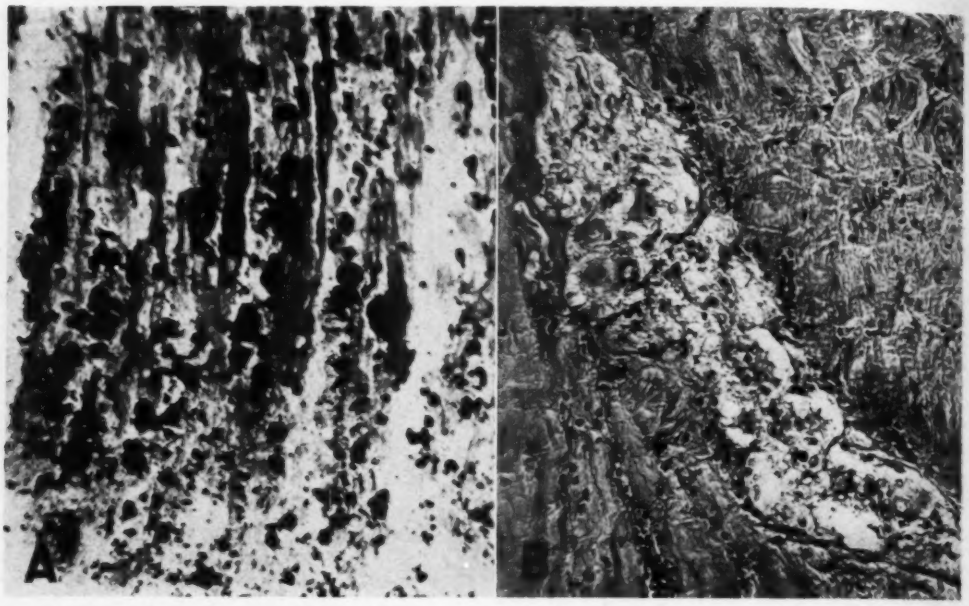

Fig. 8. Case 12: A. Photomicrograph showing advanced degeneration of the sciatic nerve with numerous coarse globules of destroyed myelin stained black by Marchi technic. (Lens combination as in Fig. 7.)
B. Ganglion of Auerbach's plexus showing edema, advanced degeneration of the neurons, and proliferation of the perisomatic glia. (Lens combination as in Fig. 7.)

nervous system in similar cases is certainly indicated and should shed further light on this problem.

ACKNOWLEDGMENT: Our thanks are extended to Dr. Carl V. Weller, Professor of Pathology and Chairman of the Department of Pathology, in whose department all the pathologic specimens reported in this paper were examined.

Special thanks are due Dr. Konstantin Scharenberg, Associate Professor of Neuropathology and Pathologist in the Neuropsychiatric Institute, for his kind advice and for his preparation and interpretation of the reproduced sections of the spinal cord, sciatic nerve, and small intestine from Case 12.

CASE HISTORIES

CASE 1: C. A., a 60-year-old telephone line foreman, experienced, about six months before his hospital admission, pain in the upper left side of the abdomen and vomiting of recently eaten food which was sometimes bile-stained. Finally he could retain only small amounts of liquid food and lost some 45 pounds in weight. The physical examination disclosed a hard mass, the size of a lemon, in the left upper quadrant. The only abnormal laboratory finding was a hemoglobin of 68 per cent. X-ray examination of the intestinal tract demonstrated an annular constricting lesion of the proximal jejunum (Fig. 3, A-1). At operation the first 10 centimeters of the jejunum were found to be dilated and thickened above an annular constricting lesion. Resection was carried out and pathologic examination showed a Grade III adenocarcinoma arising in a papilloma.

CASE 2: R. P., a 15-year-old schoolboy, had an enlarging mass with pain in the right side of the abdomen for ten months. Abdominal discomfort, weakness, ease of fatigue, loss of 19 pounds in weight occurred. The boy was able to eat well but was quickly satisfied. The only abnormalities on physical examination were minimally enlarged axillary lymph nodes and a large mid-abdominal mass. Peripheral blood examination showed no abnormality. Stools were strongly positive for occult blood. X-ray examination of the intestinal tract showed a mass in the right lower quadrant displacing small intestinal loops and deforming the cecum. Biopsy of an axillary node showed no abnormality. The patient was given a test of x-ray irradiation to the abdominal mass and, when there was slight reduction in the size, further irradiation was given. Two months later a re-examination of the upper

gastro-intestinal tract showed involvement of the duodenum with widening of the duodenal loop and irregular deformity of the lumen, presumably by a combination of intrinsic and extrinsic involvement (Fig. 3, A-2). Four weeks later, jaundice, persistent nausea and vomiting occurred. The patient became progressively worse and died nine weeks after initial hospitalization. At autopsy enlarged, matted lymph nodes compressing the duodenum and common bile duct were present, with invasion of the pancreas. Sections of nodes showed lymphosarcoma.

CASE 3: M. W., a 58-year-old housewife, had for thirty-five years had recurrent upper abdominal discomfort, belching, and occasional vomiting. Two months before admission, persistent vomiting developed. Physical examination and routine laboratory studies showed no definite abnormalities. X-ray examination showed marked distention of about 4 feet of the proximal small bowel (Fig. 3, A-3). At laparotomy, an annular constricting lesion of the lower jejunum was found and resected. Pathologic examination showed adenocarcinoma of the jejunum. Death occurred eleven days postoperatively and autopsy showed metastases to regional lymph nodes and gangrenous peritonitis.

CASE 4: B. G., a 41-year-old housewife, had her first episode of severe abdominal pain with tenderness and vomiting four months before admission to the hospital. Five days before admission nausea after eating and severe, colicky mid-abdominal pain appeared. The pain was severe enough to require morphine. The inability to eat persisted and the abdomen became distended. Physical examination showed an acutely ill, dehydrated woman. The abdomen was distended and tender, and a poorly defined mass was palpable in the left mid abdomen. Examination of the intestinal tract showed an abnormal loop of proximal jejunum (Fig. 3, B-1, 2, 3). With persistence of the colicky pain and abdominal distention, laparotomy was advised. A thickened, inflamed segment of jejunum, 14 inches in length, was found and removed. Pathologic examination of the resected specimen showed a severe non-specific ulcerative enteritis.

CASE 5: F. D., a 44-year-old housewife, was admitted to the hospital complaining of recurrent abdominal pain, distention, and slight constipation of two weeks' duration. The pain sometimes radiated to the right scapula and was partially relieved by small amounts of food taken at frequent intervals. During her two weeks' illness the patient had also noted a daily temperature elevation to 100° F. A somewhat similar attack of fever and abdominal pain had subsided spontaneously seven years previously. Physical examination showed gaseous distention and tenderness in the upper half of the abdomen. X-ray examination of the gastro-intestinal tract showed a long abnormal segment of proximal jejunum (Fig. 4, A-1, 2). On the eighth hospital day an exploratory laparotomy was performed. Excessive clear peritoneal fluid was present and the jejunal loops were thickened, edematous, and reddened. No resection or anastomosis was done. During the following seventeen months the patient became free of abdominal distress. X-ray examination at this time showed a considerably more normal appearing small bowel (Fig. 4, A-3).

CASE 6: T. H., a 22-year-old grocery clerk, when about fifteen or sixteen years of age, had had two episodes of severe bloody diarrhea thought to result from amebic infection. He was well thereafter until two months before admission to the hospital, when colicky abdominal pain, loose stools, vomiting after meals, and weakness appeared. His weight fell from 128 to 100 pounds. X-ray examination of the gastro-intestinal tract showed dilatation of the small bowel for 3 feet from the duodenum, with complete obstruction at the lower jejunum (Fig. 4, B-1, 2, 3). Surgical exploration showed the jejunum to be thick, edematous, and studded with serosal tubercles. The diseased segment was resected and uneventful recovery ensued. Pathologic diagnosis was severe chronic catarrhal ileitis without evidence of amebiasis.

CASE 7: L. S. had been operated upon at his local hospital for a suspected rupture of the appendix, and an inflammatory mass had been found involving the cecum, but the appendix could not be identified. He was transferred to the University Hospital, where two weeks later x-ray examination of the colon and upper gastro-intestinal tract was carried out. A constricting deformity of the cecal tip with associated deformity of the terminal segment of the ileum was found. This was considered to be compatible with periappendiceal abscess (Fig. 5, A-1). The lower abdominal mass diminished slightly in size with sulfadiazine and penicillin therapy. At operation, some weeks later, an inflammatory mass was found to involve the cecum and terminal ileum. It was thought that a transected appendiceal stump was identified. Recovery was uneventful.

CASE 8: G. W., a 19-year-old farm girl, had had an abrupt onset of bloody diarrhea with three to eight stools a day when ten years of age. Along with the diarrhea she had spells of abdominal distention, eructation, and occasionally vomiting. She was studied at the University Hospital eight months after the illness began, when she was found to have a severe anemia and roentgen evidence of chronic ulcerative colitis. Throughout the succeeding year she had fluctuating anemia, fever, and bloody diarrhea. With bowel movements she had cramping pains in the lower abdomen. Eight months before her second hospital admission, she developed jaundice, which persisted for two or three

months. During the jaundice she had a mildly sore tongue, as well as cracks at the corners of her mouth. Examination on the second admission showed her to be small, pale, and appearing at least five years younger than her stated age. The abdomen was somewhat distended and the liver and spleen were slightly enlarged. There was a severe anemia with a red blood count reduced to 1.4 million and hemoglobin to 1.6 gm. The red cell size was about half normal. The stools contained mucus and gross blood. Roentgen examination of the intestinal tract again showed abnormalities typical of ulcerative colitis and in addition involvement of the terminal ileum (Fig. 5, A-2).

CASE 9: G. R., a 28-year-old white female, had for ten years had moderately advanced tuberculosis with recurrently positive sputum. Sixteen months before admission to the hospital, a mass appeared in the right lower quadrant of the abdomen, which was particularly noticeable after meals. A dull, aching pain in this region with fever and occasionally nausea and vomiting developed. Physical examination showed a firm, tender, fixed mass in the right lower abdomen. The sputum contained tubercle bacilli. Roentgenographic examination (Fig. 5, A-3) showed extensive deformity and narrowing of the terminal ileum and cecum and a constricted segment in the transverse colon. At operation extensive tuberculous involvement of the ileum and cecum was found. An ileosigmoidostomy was done.

CASE 10: C. H., a 38-year-old male, began to have diffuse pain in the lower abdomen, belching, and flatus at the age of seventeen years. An appendectomy was done in 1923, several months after the symptoms had appeared, but his condition did not improve. Subsequently he had periods of nausea, generalized abdominal cramps, and pain, with swelling in the right lower quadrant of the abdomen. Watery diarrhea alternated with severe constipation. Finally persistent vomiting occurred, continuing for over a year, during which time the weight fell from 190 to 118 pounds. A severe anemia, a smooth tongue, and clubbed fingers with spoon nails developed. The upper abdomen was explored in 1935, at which time numerous adhesions between the abdominal viscera were broken up. Again there was no improvement in symptoms, and several months later the patient was referred to the University Hospital.

A severe macrocytic anemia was present. Examination of the gastro-intestinal tract (Fig. 5, B-1, 2) showed widespread alteration of the small bowel, with delay in transit, increased caliber, and loss of normal mucosal pattern. The nutritional deficiencies and anemia were corrected with specific therapy, although chronic diarrhea remained. In July 1936, the patient became worse and at operation a distended segment of the ileum above the ileocecal junction, with two localized constrictions, was found. The mesentery was thickened and edematous. Two feet of diseased ileum were resected. Pathologic examination of the specimen (Fig. 5, B-3) showed localized mucosal ulceration with scarring and inflammation throughout the thickened gut wall.

During the following eight years the patient continued to have diarrhea with abdominal distention, easy fatigue, and a macrocytic anemia requiring liver therapy. There was no particular progression in his intestinal symptoms, but his last admissions to the hospital were occasioned by the development of an acute chorioretinitis and optic neuritis.

CASE 11: M. K., a 47-year-old woman, had for six years had regurgitation after eating, with a feeling of food lodging under the lower part of the sternum. She improved after esophageal dilatation. Two years before her admission she suffered from gaseous distention, belching, early morning vomiting, and extreme constipation, which finally required the constant use of castor oil and enemas. On a few occasions stools were loose but did not contain blood. The weight gradually fell from the average 118 to 90 pounds. The appetite and desire for food remained good. Examination showed a very thin woman without evidence of vitamin deficiency or anemia. The intestinal loops were visibly distended. No neurologic abnormalities were detected on detailed search except for a questionable extensor plantar sign. Other than the abnormal roentgen findings in the gastro-intestinal tract (Fig. 6, A-1, 2, 3; B-1, 2, 3) the only abnormality was a persistent elevation of the basal metabolic rate.

CASE 12: E. R., a 27-year-old farmer's wife, became ill for the first time sixteen months before her admission to the hospital, with a low-grade fever and pain, swelling, and reddening about the ankles. She remained in bed for seven weeks. During convalescence, diarrhea appeared for a time and then recurrent distention of the abdomen, occasional vomiting, and unusual flatus. The symptoms continued and the average weight of 115 pounds fell slowly to 87 pounds. Examination showed emaciation, distention of the abdomen, and edema of the ankles. There was no evidence of vitamin B deficiency. There was no significant anemia and no evidence of neurologic disease except for roentgenographic demonstration of intestinal dysfunction (Fig. 7, A-1, 2, 3; B-1, 2). The patient was treated with a nutritious diet, vitamin supplements, yeast, calcium, intramuscular and intravenous liver extracts, and parasympatheticomimetic drugs. There was no significant response to therapy and eight months after her first admission tetany developed and death occurred. Pathologic examination showed extreme atrophy of all the organs, malnutrition, muscular atrophy, and diffuse fibrosis of the intestinal walls. Marchi preparations of the spinal cord and sciatic nerve showed advanced myelin degenera-

tion (Fig. 7, B-3; Fig. 8, A). Ganglia of Auerbach's plexus, as demonstrated in a van Gieson preparation, were swollen, their neurons were reduced in number, and the perisomatic glia was proliferated (Fig. 8, B).

SUMMARY

1. Among large numbers of patients presenting complaints referable to the small intestine a relatively small group will be found to show clearly defined roentgen signs characteristic of inflammatory and neoplastic disease.

2. The boundary line between such conditions and those which stem from neurological disturbances is not drawn with great clarity.

3. Even with a simple routine diagnostic procedure the roentgenologist can learn a great deal about the status of the small intestine.

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SUMARIO

Estudio Radiológico del Intestino Delgado. I. Enfermedades Neoplásicas e Inflamatorias

Entre los muchos enfermos que presentan síntomas imputables al intestino delgado, un grupo relativamente pequeño revela signos roentgenológicos bien definidos y típicos de afección inflamatoria y neoplásica. Al postular la existencia de tales procesos, el radiólogo se atiene en general a la presencia de deformidades de la luz intestinal, desplazamiento de los segmentos intestinales y signos de obstrucción de la luz. Sin embargo, no se define con mucha claridad la línea divisoria que separa las enfermedades neoplásicas e inflamatorias de los estados derivados de trastornos neurológicos.

Aun con un sencillo procedimiento corriente de diagnóstico el radiólogo puede averiguar mucho acerca del estado del intestino delgado. El plan de examen de los AA. consiste en una breve observación roentgenoscópica limitada al tiempo de la comida de bario y a los pocos momentos exigidos para seguir el paso del bario bien adentro en el yeyuno, seguido esto de la toma de películas inmediatamente y a plazos de 1, 2 1/2, y 5 horas. Más de 100 pacientes fueron estudiados en esta forma, y se comunican 12 casos con grabados que muestran las alteraciones radiológicas en varias lesiones orgánicas y en los trastornos funcionales.

X-Ray Signs of Altered Alimentary Function Following Autonomic Blockade with Tetraethylammonium[1]

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THE USE OF DRUGS does not play as important a role in the practice of diagnostic roentgenology as in many of the other medical specialties and, accordingly, the roentgenologist's activities in the field of pharmacology are understandably limited. His interests quite naturally are centered chiefly upon those drugs which he can put to practical use in his daily work—agents such as amyl nitrite for the temporary relief of cardiospasm, prostigmin to rid the intestinal tract of gas, and morphine to produce sphincteric contraction at the ampulla of Vater. In general, these drugs have been adopted for use in roentgenology only after their physiologic action has been adequately studied by various laboratory methods. On the other hand, it has become increasingly apparent that the roentgenologist can be of considerable assistance to the physiologist in the evaluation of unknown or questionable properties of certain drugs, particularly in regard to their actions on the digestive tract. It was largely for this reason that roentgenologic assistance was sought in a study of some interesting properties of tetraethylammonium. Superficially, at least, this agent appeared to have potentialities of being useful both practically and from the standpoint of explaining certain poorly understood aspects of gastro-intestinal physiology.

PHARMACOLOGIC BACKGROUND

Tetraethylammonium is a quaternary ammonium compound structurally similar to acetylcholine. In 1945, Acheson and Moe (1), working on heart-lung preparations of dogs, noted some interesting effects of the tetraethylammonium ion which had not been previously reported. Subsequent animal experiments (2, 3), in which reactions of the blood pressure, heart rate, and nictitating membrane were used as test responses, indicated that intravenous or intramuscular injections of the drug produced a rather specific blockade of the transmission of nerve impulses through sympathetic and parasympathetic ganglia.

CLINICAL ASPECTS

Clinical experimentation (4, 5) showed that parenteral administration of tetraethylammonium produced widespread autonomic nervous system effects consisting of postural hypotension, increase in skin temperature and blood flow in the extremities, elevation of the cardiac rate, cessation of sweating, dry mouth, fixation of the pupils in mid-dilatation, loss of ocular accommodation, and inability to void. Certain hypertensive subjects showed a significant drop in both systolic and diastolic blood pressure, and in the case of one such patient who also had a duodenal ulcer, the ulcer pain stopped completely during the period of activity of the drug. Additional investigation of this patient showed that gastric secretion was markedly decreased by the drug, but that the pain disappeared long before the stomach emptied itself of secretions already present. This finding would seem to support the concept that peptic ulcer pain is caused primarily by smooth muscle spasm,

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This project was aided by a grant from the Life Insurance Medical Research Fund and by Parke, Davis and Co.

Tetraethylammonium was supplied as "Etamon" by the Department of Clinical Investigation, Parke, Davis and Co., Detroit, Mich.

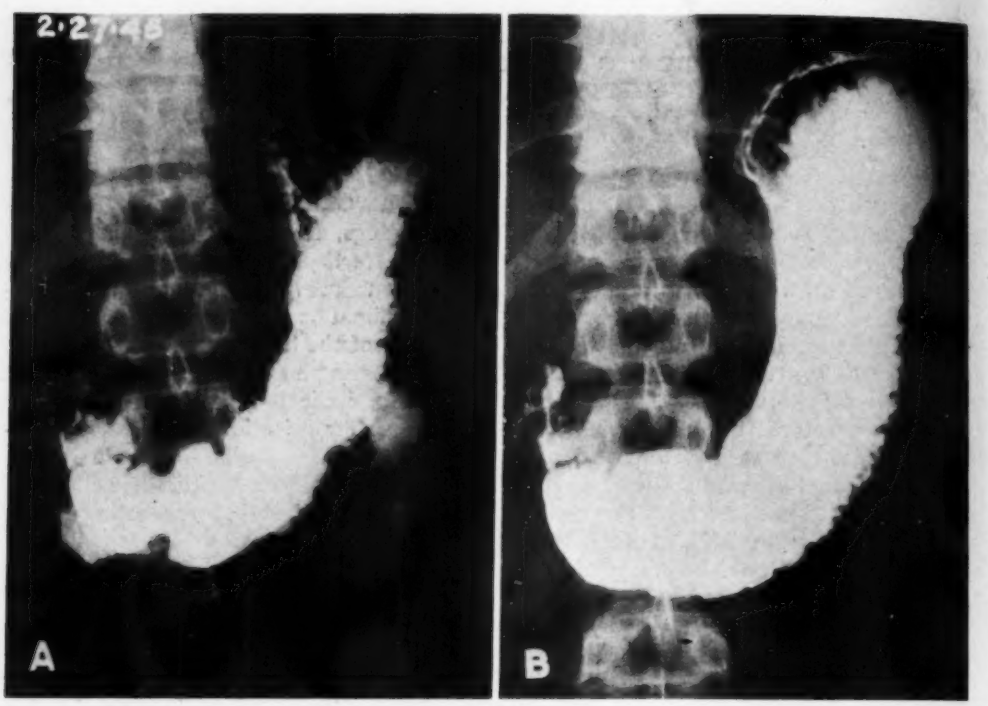

Fig. 1. A (2-27-46). Normal control. Stomach filled with 6 oz. of barium sulfate.
B (3-1-46). Similar quantity of barium in same patient's stomach a few minutes following intravenous injection of 2 c.c. of a 10 per cent solution of tetraethylammonium. Note generalized loss of muscular tone, absence of peristaltic waves, and lack of emptying at the gastric outlet. Appearance similar to atonic stomach following vagotomy (Fig. 2, B).

and not by the mere presence of acid in the stomach or duodenal bulb.

Administration of tetraethylammonium also has been found to relieve the pain and to increase the skin temperature in various peripheral vascular diseases associated with vasoconstriction. The ability of the drug to relieve vasospasm has also made it a useful diagnostic tool in assaying sympathetic tone in candidates for lumbar sympathectomy. It appears to be of limited value in the symptomatic treatment of hypertension.

ROENTGENOLOGIC OBSERVATIONS

As roentgen methods offer the most rational means of detecting altered physiologic function in the alimentary canal of man, this approach was employed in a study of the effects of tetraethylammonium on the esophagus, stomach, small intestine, and colon.

Esophagus and Stomach: It was hoped that tetraethylammonium, through its blockading action on the autonomic ganglia, might prove to be more effective in the relaxation of cardiospasm than amyl nitrite, which acts directly on smooth muscle. Four patients with cardiospasm were tested. None responded to tetraethylammonium; two showed prompt relaxation following amyl nitrite inhalation. An explanation for this apparent paradox may be found in the works of Etzel (6), Knight (7), and others, who maintain that cardiospasm is due to degeneration of the nerve plexuses in the walls of the esophagus. If such is the case, a drug which acts on nerve cells rather than on the muscle itself would have little or no effect.

Tetraethylammonium produced no visible alteration in the appearance of the normal esophagus.

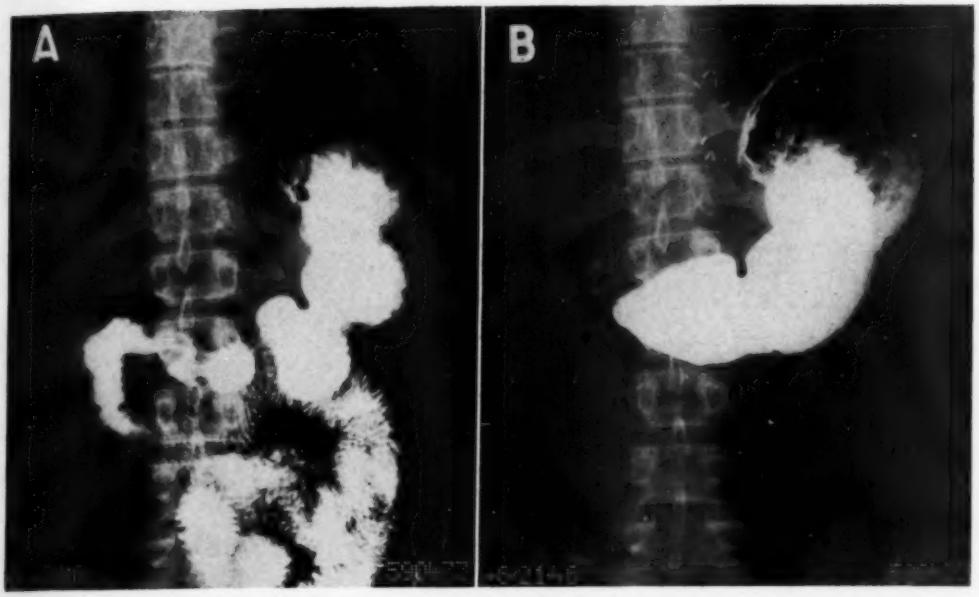

Fig. 2. Barium-filled stomach of another patient (A) before and (B) two weeks after vagotomy for treatment of duodenal ulcer. The similarity to Fig. 1 is rather striking.

Changes produced in the stomach, on the other hand, were quite definite. Intravenous injection of tetraethylammonium resulted in prompt diminution of gastric muscular tone and generalized dilatation of the stomach. All signs of peristaltic activity except a few marginal fibrillations stopped abruptly and remained quiet during the period of activity of the drug (Fig. 1). There was no appreciable escape of barium through the pylorus. With few exceptions, intramuscular injections of tetraethylammonium produced the same results except that the effects of the drug appeared more slowly and lasted over a longer period of time. In either case, the over-all appearance of the stomach was strikingly similar to that seen following vagotomy (Fig. 2).

Small Intestine: Considerable attention was given to a study of tetraethylammonium effects on the small bowel, a structure whose complex autonomic neuromuscular mechanism is still a subject of dispute.

Normal small intestinal function is largely dependent upon maintenance of a delicate balance between the sympathetic and parasympathetic components of the autonomic nervous system. Propulsive movements are readily influenced by the extrinsic nerves, *viz.*, the vagus (parasympathetic), which furnishes motor stimuli except at the sphincters, and the splanchnics (sympathetic), which are inhibitory except in sphincteric control. Similar peristaltic contractions also may be accomplished through entirely local myenteric reflexes occurring within two highly important intramural plexuses. These are the myenteric plexus of Auerbach, located between the muscle coats, and the submucosal plexus of Meissner.

In view of the ganglionic action of tetraethylammonium, it should be pointed out that the parasympathetic preganglionic fibers terminate in the intramural plexuses; thus the parasympathetic ganglia and postganglionic neurons are located entirely within the intestinal wall. On the other hand, sympathetic preganglionic fibers terminate in the celiac and mesenteric ganglia, which in turn send long postganglionic fibers directly to the muscle layers of the intestinal wall.

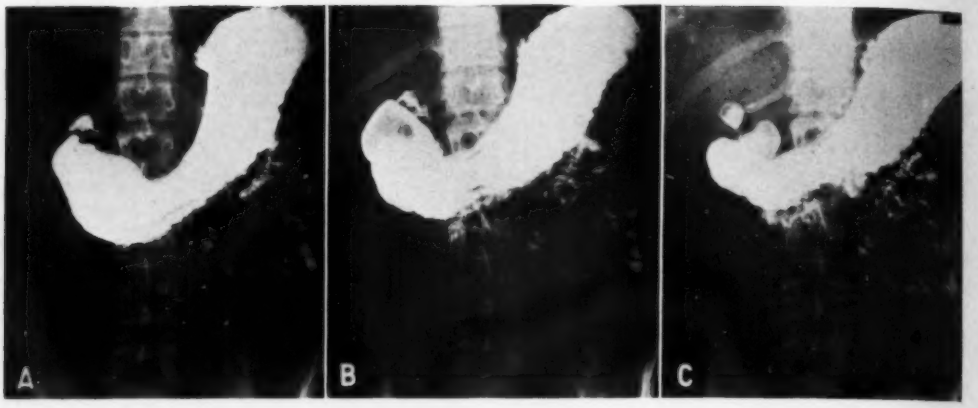

Fig. 3. A. Appearance of stomach and proximal small bowel of a 40-year-old woman shortly after intramuscular injection of 1.8 gm. of tetraethylammonium. Profound disturbance in motility following use of this drug is exemplified by exposures B and C, made one and two hours, respectively, after ingestion of barium. The mucosal pattern in the duodenum and jejunum shows no appreciable change during these long intervals.

Forssell (8) states that the intestinal mucosa moves independently of the outer muscular layers which produce peristalsis, an observation which Golden's (9) roentgenologic studies appear to confirm. Both men believe that the motor stimuli responsible for changes in the mucosal folds are supplied by sympathetic nerve fibers *via* the submucosal plexus.

The well-known rhythmical contractions of the small intestine (so-called pendulum movements) supposedly are not under control of the nervous system, but are entirely dependent upon the inherent contractile power of intestinal smooth muscle.

It will be remembered that, despite brilliant pioneer work by Forssell (10), Cole (11), and others, little attention was centered on the small intestine by roentgenologists until 1933 when Mackie (12) described abnormal changes in the form and action of the structure in a patient with sprue. Soon afterward, Snell and Camp (13) noted delayed motility and distortion of the mucosal pattern of the jejunum in chronic idiopathic steatorrhea; it was suggested that the abnormalities seen probably were not diagnostic of sprue but would be found in other conditions as well. Subsequent reports of similar functional small bowel disorders in a wide variety of primary and secondary nutritional disorders, various allergic conditions, and organic diseases of the digestive tract proved the accuracy and wisdom of Snell and Camp's prophecy. The nonspecific roentgen manifestations of altered intestinal motility and tone, abnormal segmentation of the barium column, and coarsening or obliteration of the mucosal folds came to be commonly known as the "deficiency pattern." This useful but somewhat inadequate term has been largely supplanted by the more descriptive term "disordered motor function."

Golden (9) has postulated that the apparently unrelated conditions which manifest "disordered motor function" have a common mechanism through which they are produced. He maintains that the fundamental fault lies in derangement of the intricate and poorly understood intramural nerve plexuses. Golden's theory is based on sound physiologic experimentation by numerous investigators, convincing neuropathologic findings, and extensive roentgenologic observations. The theory has not been universally accepted, but that it represents a plausible explanation of an intriguing problem cannot be denied.

Additional support to Golden's "neurogenic theory" has been contributed recently by Hodges, Rundles and Hanelin (14), who have observed small bowel dys-

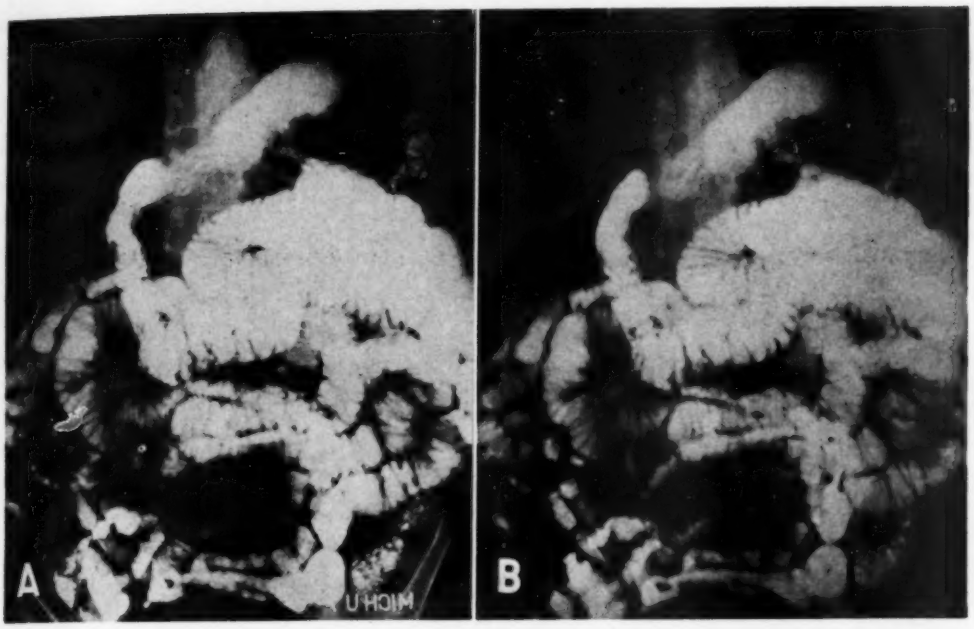

Fig. 4. Small bowel enema outlining virtually entire small intestine of a 56-year-old man; weight 179 pounds. A. Exposure made immediately following intramuscular injection of 1.6 gm. of tetraethylammonium. B. Same patient thirty minutes later. The mucosal pattern of the intestine has not changed perceptibly.

function occurring frequently in patients with various types of peripheral neuropathy. They suggest that in such patients, transient or permanent autonomic nervous system damage is responsible.

With this background in mind, it was felt that the roentgenologic appearance of "disordered motor function" might very well be produced artificially by paralyzing both parasympathetic and sympathetic ganglia through the unique action of tetraethylammonium.

A total of twelve small bowel examinations was made on eight different subjects, all of whom were well nourished, and none of whom had symptoms or signs referable to the gastro-intestinal tract. Preliminary control examinations were done where they were deemed essential. As a rule, fluoroscopic and roentgenographic survey of the barium-filled intestine prior to injection of tetraethylammonium satisfied this requirement.

An outstanding finding in every patient who received either intravenous or intramuscular injections of the drug was the profound degree to which propulsive movements of the intestine were inhibited. Even in the duodenum and proximal jejunum, where peristalsis is most vigorous, motility appeared to stop completely (Fig. 3). Fluoroscopically, it appeared as if one were observing the intestinal tract of a cadaver outlined by opaque medium.

Of further interest was the fact that in many instances careful search both at the screen and on multiple films failed to show the usual undulating, pendulum movements which are so common in the lower portion of the small bowel and which supposedly are entirely myogenic in origin. This rather dramatic cessation of intestinal movements lasted for only a few minutes following intravenous injection of tetraethylammonium, whereas an intramuscular dose of 20 mg./kg. produced similar changes which persisted for as long as three hours.

Perhaps the most striking change of all in this series of observations was the man-

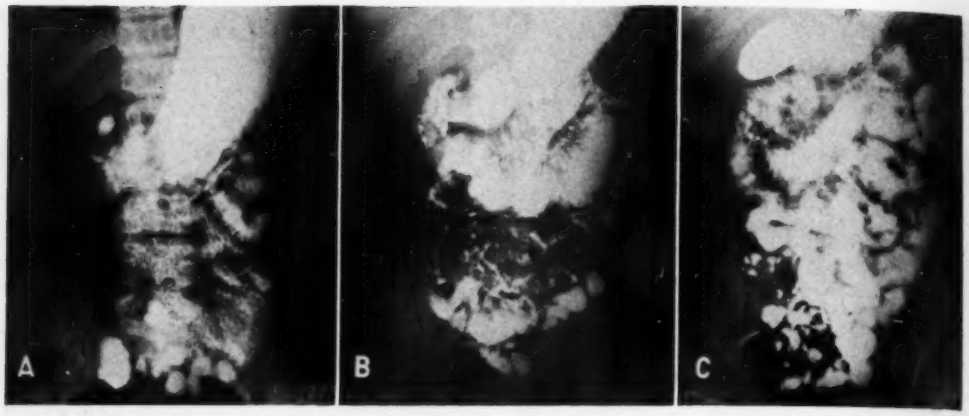

Fig. 5. A. Normal feathery pattern of jejunum in a 15-year-old girl. Head of barium column has entered proximal ileum.
B. Several minutes after intramuscular injection of 1.2 gm. of tetraethylammonium, fluoroscopy showed the small bowel to be "frozen" in this somewhat abnormal pattern (the change may be entirely coincidental).
C. Ten minutes after subcutaneous injection of 25 mg. of mecholyl, peristalsis was seen to be very active and distribution of barium appeared more normal.

ner in which the mucosal markings of the small intestine appeared to be fixed in one position by tetraethylammonium over a period of minutes or hours. This feature was not a constant finding in every case, but it occurred too often to be considered merely coincidental. The phenomenon was shown to best advantage following a small bowel enema. Employing the technic described by Schatzki (15), the entire small bowel was filled with barium, and fluoroscopy showed intestinal movements to be quite active. The usual intramuscular dose of tetraethylammonium was injected, and within three or four minutes all intestinal movements had stopped. Interval films showed no perceptible change in the pattern of the mucous membrane folds over a period of thirty minutes (Fig. 4).

It must be admitted that all features of a well defined "deficiency pattern" of the small intestine were not produced in most of the patients examined. In addition to profound disturbances in motility, however, some degree of coarsening of the mucosal markings and slight generalized dilatation of the entire small intestine usually were evident. Thus, the appearance of the bowel could not be considered entirely normal.

In one patient, marked variation in the caliber of the intestinal lumen appeared immediately after injection of tetraethylammonium, and this was associated with abnormal segmentation of the barium column and the usual absence of propulsive movements. Subcutaneous injection of acetyl-beta-methyl choline (mecholyl), through its direct action on smooth muscle, immediately precipitated peristalsis and, at the same time, gave the mucosal pattern a more normal appearance (Fig. 5).

Atropine alone, through its paralyzing action on the parasympathetic nervous system, and adrenalin, which stimulates the sympathetics, were found to produce some inhibition of intestinal motility, but the degree of change was not so pronounced as it was with tetraethylammonium. Furthermore, regular movements of the mucosa persisted despite large doses of either atropine or adrenalin.

Colon: Changes in motility of the colon are difficult to detect because progress of the barium meal in this region is so slow. Tetraethylammonium produced no appreciable change in the haustral pattern of the normal colon, although it was found that during the period of activity of the drug, the large bowel could be markedly distended without producing a desire to defecate.

SIGNIFICANCE OF FINDINGS

The admittedly limited observations herein reported bring up a number of questions concerning gastro-intestinal physiology which, in the present state of our knowledge, must remain unanswered or, at best, be subject to mere speculation. These questions will be dealt with in a subsequent publication (16) following more extensive laboratory experimentation and a more careful correlation of the data thus far obtained with existing anatomical and physiological facts.

SUMMARY

Tetraethylammonium is a simple organic compound which possesses a recently recognized property that is unique among known pharmaceutical agents. Parenterally administered, the drug appears to block the transmission of impulses through the autonomic ganglia—both sympathetic and parasympathetic.

Preliminary roentgenologic observations indicate that the drug produces diminution of gastro-intestinal tone and causes virtually complete cessation of motility in the small bowel. In many instances, movements of the small intestinal mucosal folds are completely stopped for relatively long periods of time. This is in contradistinction to the action of atropine and adrenalin, both of which produce some decrease in motility but neither of which has any appreciable effect on mucosal movements.

Artificial paralysis of autonomic ganglia does not consistently produce all of the classical roentgenologic features of "disordered motor function" of the small intestine as seen in various nutritional disorders, gastro-intestinal allergy, diabetic neuropathy, and other conditions.

Although the therapeutic value of tetraethylammonium at present is distinctly limited, further study of its properties may find it a place in medical management. In the meantime, the drug should prove to be a useful agent in further investigation of both the normal and disordered autonomic nervous system.

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DISCUSSION

Walter L. Palmer, M.D. (Chicago): This has been a fascinating paper. It raises, of course, many questions and many problems for discussion. I wish merely to discuss the mechanism of ulcer pain.

The relief of ulcer pain by the use of tetraethylammonium was interpreted as evidence that the pain is caused by smooth muscle spasm. I would suggest that it does not constitute such proof at all. The pain of duodenal ulcer is due to acid acting on

the surface of the ulcer. The drug immediately halts peristaltic activity and stops the emptying of the stomach, as the authors have shown quite conclusively. Anything which does that will immediately relieve the pain of a duodenal ulcer, because the surface of the lesion is then bathed with alkaline duodenal content.

Of course, when an ulcer is sensitive, pain can be induced by muscle spasm, but the sensitivity of the ulcer itself is produced by the action of the acid. Pain is ordinarily due to the action of the acid gastric juice. I think we can interpret the relief of pain from tetraethylammonium as due to the prompt cessation of gastric emptying, so that the ulcer is bathed with the alkaline duodenal contents instead of the acid gastric juice.

SUMARIO

Signos Radiológicos de Disfunción Alimenticia Consecutivamente a Bloqueo del Autónomo con Tetraetilamonio

El tetraetilamonio es un compuesto orgánico simple que posee una propiedad, reconocida recientemente, que es única para los elementos farmacéuticos, y que consiste en que, administrada parentéricamente, la droga parece bloquear la trasmisión de impulsos por los ganglios del sistema autónomo, tanto del simpático como del parasimpático.

Las observaciones roentgenológicas preliminares indican que la droga atenúa la tonicidad gastrointestinal y hace cesar, virtualmente por completo, la movilidad del intestino delgado. En muchos casos, se paran completamente los movimientos de los pliegues de la mucosa de dicho intestino durante períodos relativamente largos de tiempo. Esto es en contraposición al efecto de la atropina y la adrenalina, pues aunque ambas provocan alguna disminución de la movilidad, ni una ni otra ejercen efecto apreciable sobre los movimientos de la mucosa.

La parálisis artificial de los ganglios del autónomo no produce constantemente todas las clásicas características radiológicas de la "disfunción motriz" del intestino delgado, tal como se observa en varios trastornos nutritivos, la alergia gastrointestinal, la neuropatía diabética y otros estados.

Si bien el valor terapéutico del tetraetilamonio es hoy día bien limitado, el estudio ulterior de sus propiedad puede encontrarle un puesto en la asistencia médica. Entre tanto, la droga debe resultar útil para nuevos estudios del sistema nervioso autónomo tanto normal como trastornado.

Acute Obstruction of the Small Bowel

Value of Roentgen Examination in Early Diagnosis[1]

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THE MATERIAL for this paper has been collected during the past fifteen years from the records of the Maine General Hospital, where it has been a routine procedure during this period to take a "scout film" in all undiagnosed acute abdominal cases, particularly cases in which intestinal obstruction is suspected. Three hundred and fifty cases of either small or large bowel obstruction have been studied. Of these, 100 cases have had both roentgen-ray studies and surgical confirmation of the diagnosis of small bowel obstruction.

The purpose of this paper is to correlate the roentgen with the surgical findings in this latter group of cases. It is further our purpose to show, as has frequently been reported by others, that with adequate roentgen study, not only is the diagnosis highly accurate, but the location of the lesion may be approximated in a large percentage of cases and in some the nature of the obstruction may be anticipated. Cases of external hernia and of carcinomatosis and peritonitis, where the obstruction was of secondary importance, have been excluded. This corresponds to reports from the Massachusetts General Hospital by Scudder, Richardson, McIver, McKittrick and Sarris.

Since Case, in 1920, reported on "a new aid in the early recognition of postoperative ileus," a mass of literature has appeared on this subject. This has been adequately reviewed in the recent books of Wangensteen and Golden and no attempt will be made to reduplicate their extensive studies.

ROENTGEN STUDY

For the past fifteen years, it has been our routine practice to obtain a "scout film" in all acute abdominal cases. This is studied immediately. If further information is desired, an upright film may be taken including the diaphragm, to determine the presence of a pneumoperitoneum or fluid levels. A decubitus film with the right or left side up, or a lateral view in the supine position if the patent is acutely ill, will give the same information and will also help to identify further the point of obstruction. In the study of all films the following points are kept in mind:

1. Abnormal gas shadows, due to:
   (*a*) Intestinal tract (what part?)
   (*b*) Pneumoperitoneum
   (*c*) Air in biliary tract
2. Possible causes of mechanical or reflex ileus
   (*a*) Gallstones
   (*b*) Renal stones
   (*c*) Fecaliths
   (*d*) Foreign bodies
3. Abnormal soft-tissue shadows
4. Bone abnormalities

For the purpose of this analysis, the presence of abnormal intestinal gas will be discussed. Air in the small bowel, except in the very young, is abnormal but does not necessarily indicate obstruction.

After an enema, fluid and gas may pass through the ileocecal valve into the small bowel, but in such cases the gas is minimum in amount and is limited to the terminal ileum, which shows no dilatation. Occasionally in the presence of a large bowel obstruction segments of small bowel may show dilatation. In one of our cases this was explained on the basis of obstruction not only of the large bowel but also of the terminal ileum.

The occurrence of gas in the small bowel after instrumentation for retrograde pyelography is a familiar observation and the

[1] Presented at the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–6, 1946.

Fig. 1. Case of renal colic with gas in the large and small bowel. A segment of small bowel in the region of the left sacroiliac joint is outlined with gas, and mucosal folds (Kerkring's folds) can be identified. There is no evidence of mechanical obstruction in this case.

same holds true for any acute abdominal pain. At times it may be difficult to decide whether this gas is of primary importance, but usually the history, plus the fact that the bowel is not dilated, will help to determine the significance of these changes (Fig. 1). The important point, therefore, is not only whether or not gas is present, but whether there is dilatation of the small bowel.

An attempt should be made to determine the location of the gas and thereby estimate the location of the obstruction. In general, it may be stated that the jejunum is mostly in the left upper abdomen, extending to the left lower quadrant, while the ileum is to the right, extending into the right lower quadrant and pelvis. When the bowel is markedly distended however, the positions may be altered so that this observation, though it may be quite helpful, is not entirely dependable.

The anatomical characteristics (Table I) give the most important information. The lumen of the jejunum is the widest part of the small intestine. The circular or transverse mucosal folds (valvulae conniventes or Kerkring's folds) are higher, closer, and thicker than those of the ileum and cannot be obliterated. The ileum has a narrower lumen; the mucosal folds are fewer in number, are slender, shallow, and can be obliterated in the distended segments. With a small amount of gas in the jejunum

Fig. 2. "Hairpin" loop of dilated small bowel due to adhesions causing early obstruction of ileum.

a typical "feathery" appearance is evident, which changes to a "herring-bone" or "coil-spring" pattern as dilatation increases. The wall, therefore, appears straighter and thinner (Fig. 3).

In lower jejunal obstruction the mucosal folds become straighter, giving a "squaring" of the segments. For this reason it is sometimes difficult to distinguish this portion of the small bowel from the colon. In such cases a barium enema may be necessary for differentiation. In selected cases further study by means of the Miller-Abbott tube and barium injection may be helpful in localization.

As the more distal segments of the ileum are involved, the mucosal folds become fewer, wider apart, and more easily ob-

TABLE I: ANATOMICAL AND ROENTGEN RAY CHARACTERISTICS OF INTESTINAL TRACT

	Jejunum	Ileum	Colon
Location	Left upper quadrant	Right lower quadrant	Laterally, except for transverse colon, which can be seen in continuity with lateral portions
Thickness of walls	Thick	Thin	Thicker
Lumen	Widest part of small intestine	Not so wide as jejunum	Widest portion of intestine
Mucosal folds (circular folds)	Kerkring folds Higher Closer Thicker	Circular folds Shallower Fewer Thinner	Coarse haustral markings
Appearance with distention	"Feathery" appearance with a small amount of gas "Herring-bone" or "coil-spring" appearance as distention increases Straight, thin walls	Characterless appearance, with folds becoming obliterated	Haustral markings with scalloped effect
	Fluid levels	Fluid levels	Long single fluid level

In mid bowel (low jejunum and upper ileum) the "coil spring" appearance is lost and folds become straight, giving a "squaring" effect. "Hairpin" loop: early or partial obstruction. Ladder formation: late obstruction.

literated, giving a "characterless" appearance to the markedly dilated loops.

The colon is distinguished by its haustral markings and the fact that it lies laterally, except for the transverse colon, which is in continuity with the lateral areas. Its walls are thicker and dip downward, the haustral markings giving a scalloped appearance.

ANALYSIS OF DATA

The roentgen findings indicating small bowel obstruction were conclusive in 94 cases out of 100 (Table II). Of the inconclusive cases, one was observed for three days and on the final film small bowel obstruction was diagnosed. Another case was observed for three days with a Miller-Abbott tube inserted. The findings were suggestive but not conclusive of obstruction due to decompression by suction. In both of these cases an obstruction was found at operation. In a third case no gas was seen and no fluid levels were present on any of the films, but at operation there was a definite obstruction 30 cm. from the ileocecal valve. The bowel above the obstruction was markedly distended with fluid but contained practically no gas.

In 50 cases the location of the obstruction was stated in the operative notes. The films on these cases were studied without reference to the operative record and the location of the obstruction given at one of three levels; namely, jejunum, mid small bowel (low jejunum and upper ileum), and terminal ileum. In every instance the approximate level as determined from the roentgenogram corresponded to the operative finding. The obstruction was in the terminal ileum in 33 cases, in the mid small bowel in 9 cases, and in the jejunum in 6 cases. In 8 cases a barium enema was necessary for localization of the gas.

There were 2 cases with negative findings when first examined, but during an attack of intestinal colic a dilated loop of small bowel was seen. This examination was suggested by Dr. Isaac M. Webber.

The cause of the obstruction could be determined in only 5 cases. In one case a gallstone was seen in the jejunum, which was dilated above the site of obstruction. Also gas was visible in the gallbladder, indicating a fistula between the gallbladder and intestinal tract (Fig. 8). In another, air was seen in the gallbladder and the stone was also demonstrated (Fig. 7).

There were 4 cases of intussusception. One was diagnosed as due to a carcinoma of the cecum (Fig. 9). In another, the intussusception was suspected as the cause of the obstruction. Two others were due to fibromata of the small bowel, but only the resulting obstruction was diagnosed.

In another case, the cause and location of

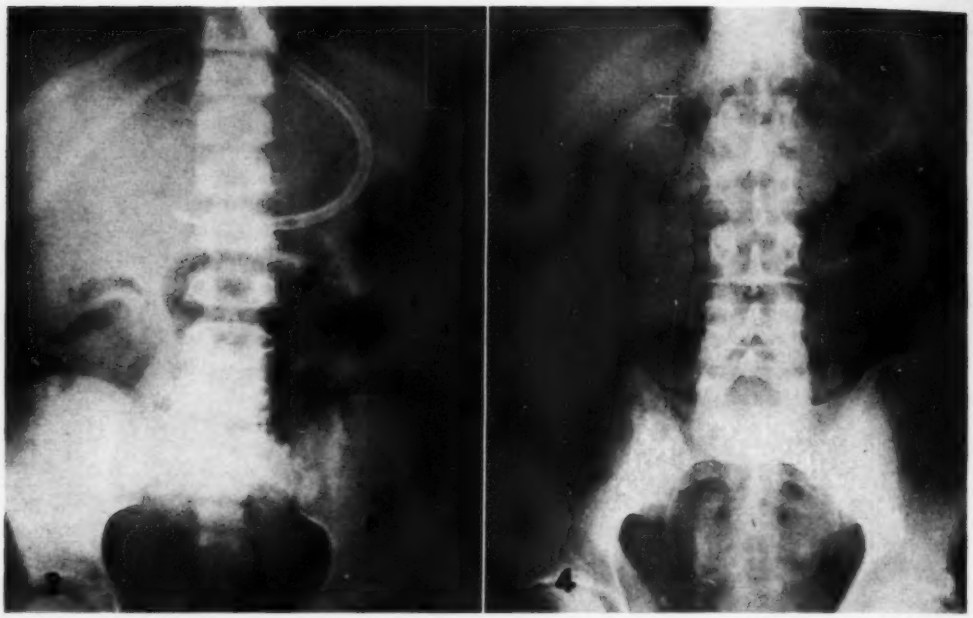

Fig. 3. Early high jejunal obstruction. Note "feathery pattern" of dilated jejunum.
Fig. 4. Low jejunal obstruction (compare with Fig. 3). Note that dilatation is greater, the feathery pattern is replaced by a herring-bone pattern, and the folds are apparent in the mid jejunal loop just above the left iliac crest.

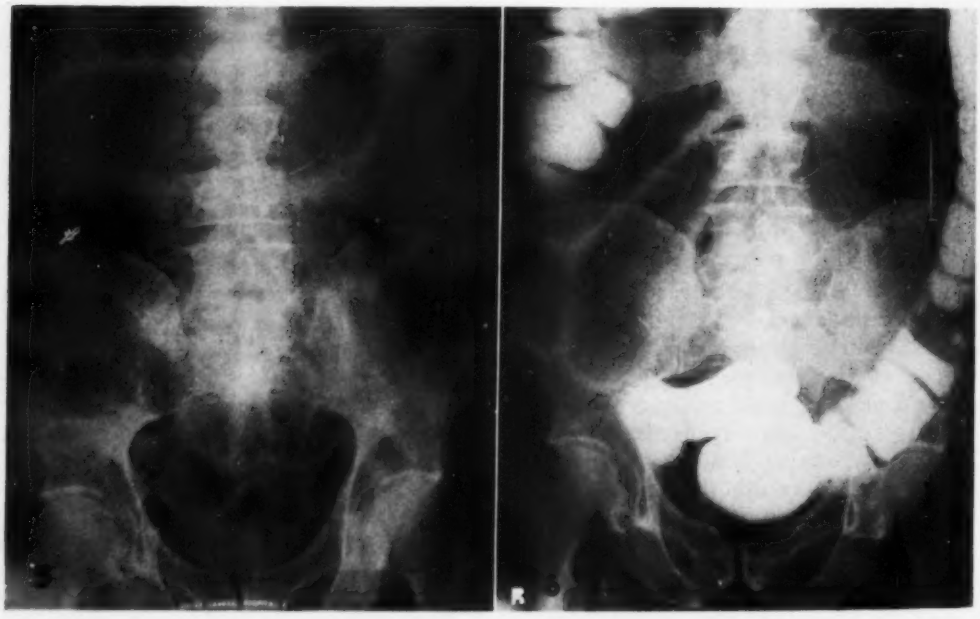

Fig. 5. Obstruction at terminal ileum. Note herring-bone pattern and ladder formation of jejunum in the left upper quadrant and left lower quadrant. "Characterless" dilated loops of terminal ileum in right lower quadrant.
Fig. 6. Same case as Fig. 5 after barium enema. Operation showed an adhesive band causing obstruction between the terminal ileum and ascending colon.

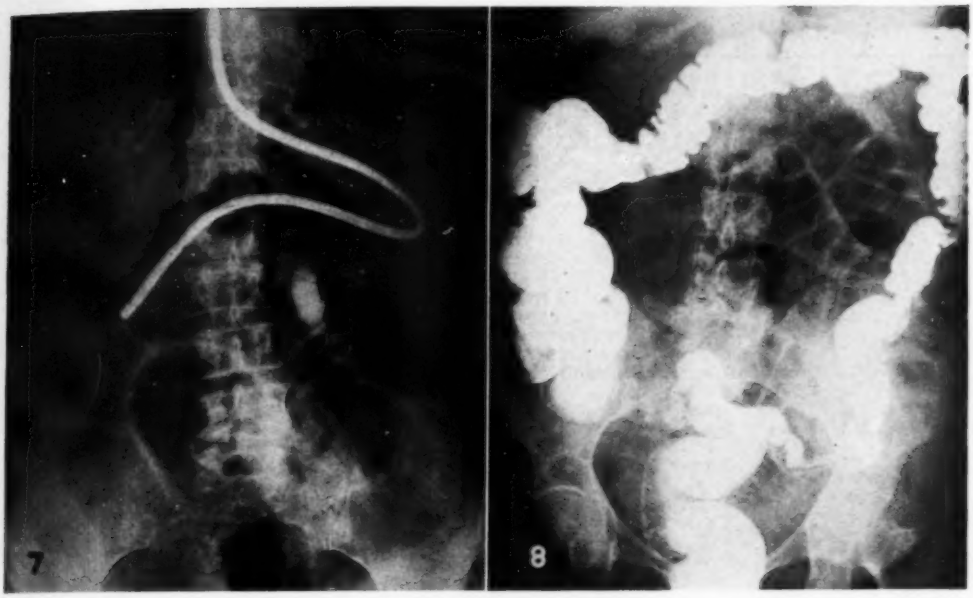

Fig. 7. Obstruction due to gallstone with air in the gallbladder also demonstrated.
Fig. 8. Gallstone causing obstruction. Air in the biliary tract is demonstrated. The gallstone is not identified but was found at operation.

the obstruction were demonstrated by barium enema studies (Figs. 10 and 11). There were adhesions between the sigmoid and the cecum, causing a partial intermittent obstruction of both, with rotation and volvulus of the cecum, the ileum being lateral to the ascending colon and also obstructed. This illustrates the fact that where there is both small and large bowel dilatation a double obstruction should be suspected, although with a single large bowel obstruction there may be gas in the small as well as the large bowel.

The causes of obstruction as determined at operation are given in Table III. In 78 per cent of the cases the obstruction was due to adhesions, and of this group of patients, 55 had had previous laparotomies. There were 3 cases due to Meckel's diverticulm which were not diagnosed as such.

A study of the mortality in this series of cases revealed 23 deaths. Of these, 7 were due to conditions other than the obstruction, reducing the actual mortality from obstruction and infection to 16 cases. Forty cases were seen before 1940, with 13 deaths (32 per cent) and 60 cases after 1940, with 10 deaths (16 per cent).

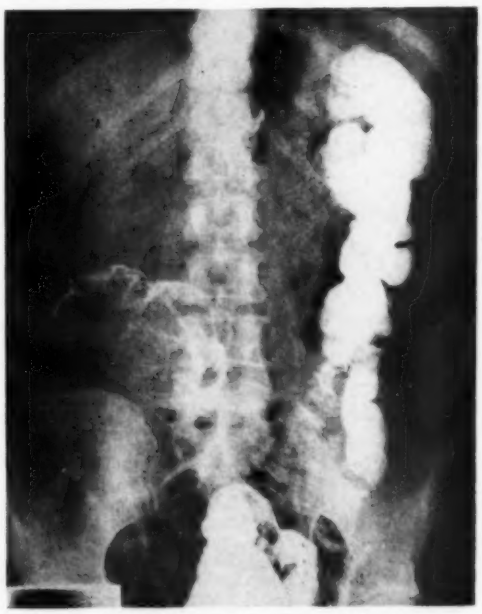

Fig. 9. Intussusception due to tumor in the cecum. The mass is identified and gas is seen in the terminal ileum.

TABLE II: DATA ON 100 CASES OF MECHANICAL OBSTRUCTION OF THE SMALL BOWEL

Hosp. No.	Age	Previous Operation	Roentgenologic Conclusions	Operative Findings as to Cause of Obstruction	Survival
38485	9	Yes	Partial obstruction	Adhesions	Yes
37591	46	Yes	Ladder formation	Adhesions	Yes
39410	30	Yes	Partial obstruction	Adhesions	Yes
32332	60	Yes	Suggestive of partial obstruction (Review of films: definite obstruction)	Adhesions	No
32127	45	Yes	Ladder formation indicating small bowel obstruction	Adhesions	Yes
34576	84	Yes	Small bowel obstruction	Adhesions	Yes
54700	69	Yes	Small bowel obstruction	Adhesions	Yes
1925	64	Yes	Obstruction near ileocecal valve	Adhesions	Yes
1610	70	Yes	Partial obstruction with increase in dilatation over 24-hour period	Adhesions	Yes
5115	27	Yes	Partial small bowel obstruction	Adhesions	Yes
42053	28	Yes	Probable obstruction	Adhesions	Yes
41755	7	Yes	High small bowel obstruction	Adhesions	Yes
45266	20	Yes	Partial obstruction	Adhesions	Yes
44857	18	No	Partial obstruction	Adhesions	No
45175	36	Yes	Intestinal obstruction	Adhesions	No
36799	32	Yes	Small bowel gas but not sufficient to make diagnosis of obstruction	Adhesions	Yes
22576	75	?	No evidence of obstruction	Obstruction 30 cm. from ileocecal valve; fluid above obstruction	Yes
37900	63	Yes	Small bowel obstruction	Adhesions	Yes
2036	65	No	Partial obstruction	Adhesions	Yes
53671	53	Yes	Dilated loops of small bowel	Adhesions	Yes
54165	66	No	Small bowel obstruction	Adhesions	Yes
47533	47	No	Small bowel obstruction	Adhesions	Yes
49918	48	Yes	Partial small bowel obstruction	Adhesions	Yes
50433	39	Yes	Obstruction near terminal ileum	Adhesions	Yes
30514	32	Yes	Small bowel obstruction	Adhesions	Yes
31010	55	Yes	Partial obstruction	Adhesions	Yes
50046	44	Yes	Partial small bowel obstruction	Adhesions	Yes
14221	30	Yes	Dilated loops of small bowel	Adhesions	Yes
46691	39	?	Films inconclusive	Adhesions	Yes
18920	24	No	Partial obstruction	Adhesions	Yes
19541	35	Yes	Small bowel obstruction near ileocecal valve	Adhesions adherent to fundus	Yes
11102	64	?	Small bowel obstruction	Adhesions	Yes
10504	83	Yes	Partial small bowel obstruction	Adhesions and gangrenous gut	No
5526	45	Yes	Small bowel obstruction	Adhesions	Yes
12982	48	Yes	Early partial small bowel obstruction	Adhesions	Yes
11758	54	Yes	Observed for 3 days. Partial small bowel obstruction on final film.	Adhesions	Yes
16191	73	No	Partial small bowel obstruction	Adhesions	Yes
29145	50	Yes	Small bowel obstruction	Adhesions	No
30403	71	Yes	Suggestive of small bowel obstruction	Adhesions	No
40326	24	Yes	Gas in small and large bowel; question of partial obstruction: question of ileus	Adhesions under scar	No
2460	24	Yes	Partial obstruction, ileum	Adhesions to scar	No
50041	68	Yes	Intestinal obstruction	Adhesions	Yes
51432	68	No	Partial intestinal obstruction	Adhesions	Yes
4959	15	Yes	Intestinal obstruction	Loop adherent to McBurney incision	No
2483	13	Yes	Partial small bowel obstruction	Small intestine adherent to scar	Yes
51820	61	Yes	Intestinal obstruction, small bowel	Adhesions to wall in region of old scar	Yes
26185	42	Yes	Intestinal obstruction	Pelvic adhesions	No
51306	37	Yes	Partial intestinal obstruction	Pelvic adhesions	Yes
6188	46	Yes	Partial small bowel obstruction	Multiple adhesions	No
36951	79	?	Small bowel obstruction	Adhesions, bands	No
50889	28	Yes	Ladder formation. Small bowel obstruction	Adhesions, bands	Yes
19410	17	Yes	Partial small bowel obstruction	Adhesions, bands	Yes
20634	31	?	Partial small bowel obstruction	Adhesions, bands	Yes
119	33	?	Partial small bowel obstruction	Adhesions, bands	Yes
5173	46	Yes	Hairpin loop indicating obstruction	Adhesions, bands	Yes

TABLE II: DATA ON 100 CASES OF MECHANICAL OBSTRUCTION OF THE SMALL BOWEL (CONCLUDED)

Hosp. No.	Age	Previous Operation	Roentgenological Conclusions	Operative Findings as to Cause of Obstruction	Survival
29430	69	No	Small bowel obstruction	Adhesions, bands	Yes
3820	70	Yes	Small bowel obstruction	Adhesions, bands	Yes
47599	50	Yes	Intestinal obstruction	Adhesive band from base of bladder to mesentery of ileum	Yes
46893	59	?	Partial obstruction	Adhesive band of omentum in region of cecum	No
51517	50	Yes	Small bowel obstruction	Adhesive bands	Yes
50037	32	Yes	Small bowel gas with slight dilatation	One adhesive band attaching loop of upper ileum to sigmoid	Yes
54267	75	Yes	Small bowel obstruction	Adhesive band from diverticulum of sigmoid to posterior wall, obstructing terminal ileum	Yes
54266	43	No	Gas-filled loops of small bowel with no dilatation. Observed 3 days with Miller-Abbott tube; small bowel gas still demonstrated	Moderately distended small bowel due to adhesive band	Yes
47724	76	?	Probable intestinal obstruction, in ileum	Fibrous band from omentum obstructing terminal ileum	Yes
14585	78	No	Intestinal obstruction	Adhesion of ileum to gallbladder	Yes
45634	23	Yes	Partial obstruction	Pelvic adhesions with volvulus	Yes
29896	41	Yes	Dilated loops of small bowel indicating mechanical obstruction	Adhesions with volvulus	Yes
28966	22	Yes	High small bowel obstruction	Adhesions with volvulus	No
9930	41	Yes	Partial small bowel obstruction	Adhesions with volvulus	Yes
53381	42	No	Partial obstruction	Volvulus	No
4300	42	No	Partial obstruction, terminal ileum	Adhesions with volvulus	Yes
30894	70	No	Partial obstruction	Adhesions with volvulus	Yes
19070	46	Yes	Small bowel obstruction	Adhesions with volvulus	Yes
37455	58	No	Small bowel obstruction	Femoral hernia with obstruction	Yes
48305	60	Yes	High intestinal obstruction	Incisional hernia with jejunum knuckled by adhesive band	Yes
14215	81	Yes	Hernia demonstrated with dilated segment of small bowel	Strangulated femoral hernia	No
54931	76	No	Probable partial intestinal obstruction	Direct inguinal strangulated hernia (Richter type)	Yes
56704	70	Yes	Partial intestinal obstruction	Strangulated femoral hernia	Yes
16839	71	Yes	Intestinal obstruction	Large hernia	No
16603	62	Yes	Probable small bowel obstruction	Hernia through McBurney incision	Yes
42983	51	No	Ladder-like arrangement of dilated loops indicating intestinal obstruction	Femoral hernia	No
44310	31	?	Obstructing lesion in terminal ileum	Meckel's diverticulum	Yes
23082	50	Yes	Dilated loops of small bowel	Meckel's diverticulum	Yes
2645	6	No	Partial small bowel obstruction	Meckel's diverticulum with intussusception	Yes
46809	64	Yes	Partial obstruction	Fibroma, small bowel, with intussusception	Yes
6498	59	Yes	Obstructing lesion near ileocecal valve	Fibromyoma	Yes
20106	56	No	Intussusception due to polypoid tumor in region of cecum	Carcinoma 10 cm. above ileocecal valve; 30 cm. ileum showing intussusception	Yes
38430	70	No	Small bowel obstruction caused by gallstone	Gallstone causing obstruction	No
865	66	No	Obstructive lesion in ileum	Gallstone causing obstruction 3 feet beyond ileum	No
49201	74	No	Partial intestinal obstruction	Obstruction due to gallstone	Yes
3612	55	No	Small bowel obstruction	Terminal ileitis	No
24327	57	No	Small bowel obstruction	Terminal ileitis	Yes
43307	23	Yes	Small bowel obstruction	Tuberculosis, terminal ileum	Yes
51422	58	Yes	Partial small bowel obstruction	Metastatic node	Yes
49299	63	No	Small bowel obstruction	Mass of adhesions	No
48585	70	Yes	Dilated small and large bowel	Carcinoma of colon with large and small bowel obstruction	No
24327	57	No	Smal! bowel obstruction	Pelvic mass	Yes
50341	65	Yes	Smalf bowel obstruction	Pelvic adhesions	No
38496	45	Yes	Partial obstruction	Fibrous lesion, terminal ileum	Yes
38193	62	Yes	First film inconclusive; 4 hours later definite obstruction	Adhesions in area of terminal ileum Toothpick perforated ileum 7 months previously	Yes

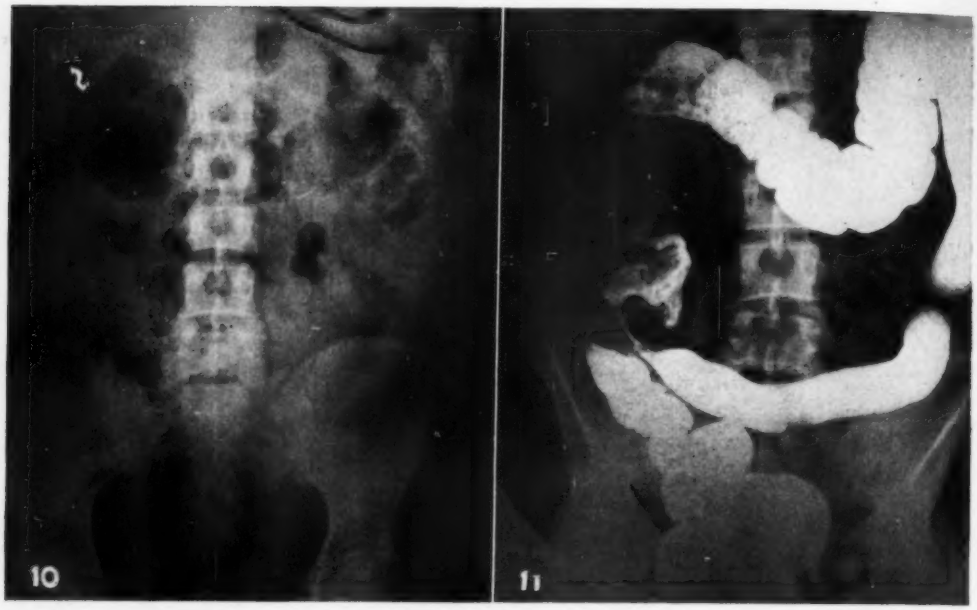

Fig. 10. Dilatation of the small and large bowel. The segment in the right lower abdomen has the appearance of colon.

Fig. 11. Same case as Fig. 10. A barium enema study demonstrated the sigmoid in the right lower quadrant and a markedly dilated cecum. Operative findings demonstrated a volvulus of the cecum and also obstruction at the terminal ileum.

DISCUSSION

It must be emphasized that there are a large number of cases presenting problems in the diagnosis of obstruction that will require frequent examination of the abdomen, including palpation and auscultation as well as repeated radiographic studies. The selection of cases that have been verified surgically necessarily limits the doubtful cases and allows for a more accurate correlation of the roentgen and operative findings.

In this series the radiographic findings were accurate in 94 per cent of the cases. In addition, in 50 cases in which the point of obstruction was stated in the operative notes, operation and the radiographic findings accurately located the level.

Always it should be stressed that, important as they may be, the roentgen findings are only an adjunct to the history and physical examination and other laboratory data. All should be correlated before coming to a definite conclusion as to the final diagnosis.

TABLE III: MECHANISM OF OBSTRUCTION. ANALYSIS OF 100 CASES OF SMALL BOWEL OBSTRUCTION

Adhesions with previous laparotomy	55
Adhesions without previous laparotomy	15
Adhesions: previous operation not stated	8
Internal hernia	8
Meckel's diverticulum	3
Gallstones	3
Fibroma (causing intussusception)	2
Intussusception (one due to carcinoma of cecum)	2
Adhesions due to carcinoma not diagnosed previously	1
Tuberculous ileitis	1
Terminal ileitis	2
	100

SUMMARY

1. One hundred cases of obstruction of the small intestine were studied and operative and roentgen findings correlated.

2. The radiographic findings were conclusive of obstruction in 94 per cent.

3. The level of obstruction can be localized roentgenographically, *i.e.*, jejunum, mid bowel, or ileum.

4. The importance of taking a "scout film" first and special views as necessary, depending on the history, physical findings, and the first film, is stressed.

5. The anatomy of the small bowel is discussed in relation to the radiographic changes.

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DISCUSSION

Arthur J. Present, M.D. (Tucson, Ariz.): Excluding fractures, there is probably no x-ray emergency which calls us to the office more frequently than acute intestinal obstruction. There is certainly no emergency in which our services can be more helpful if we are careful in the manner in which we study the cases. I hope that our results can be as good as those of the essayists, who are to be complimented.

The radiologist has an opportunity to be helpful in a critical situation and therefore a thorough roentgen study is indicated. Not only must he obtain films adequate from a technical point of view but he cannot rest on the wet film diagnosis where he frequently finds himself cornered for an opinion.

It cannot be over-emphasized that *all* the information on a film should be considered. We can frequently find indications as to the level or the source of the obstruction from minute details, not always as clear-cut as the gallstones which we have seen demonstrated. I think the careful survey of the abdominal film is most important to exclude the possibility of free gas in the peritoneal cavity as evidence of perforation following obstruction, since that is undoubtedly the most serious complication.

We have found that the initial examination, no matter how careful, is often not adequate—which suggests decubitus films, upright films, and flat films—but we must examine the patient frequently in order to find the source or the level of obstruction, or even to confirm its presence.

I should like to emphasize the fact that, even though it causes considerable discomfort, we have often found it useful to turn our patient over, for prone films, thus obtaining considerable information as to the caliber of the involved bowel and also a compression effect. We have also had success frequently by decompression and re-examination.

The last thing I should like to say is that we have been fooled—and I am sure others have been—by a normally functioning colon in the presence of small bowel obstruction. That warning I hand on because we have seen perfectly normal bowel movements in the presence of obstruction.

SUMARIO

Diagnóstico Temprano de la Obstrucción Aguda del Intestino Delgado

Al estudiar 100 casos de obstrucción del intestino delgado y correlacionar los hallazgos operatorios y roentgenológicos, los últimos resultaron terminantes en cuanto a la presencia de obstrucción en 95 por ciento de los casos. La radiografía permitió localizar el nivel de la obstrucción: yeyuno, mitad del intestino o ileon.

Recálcase la importancia de obtener primero una película "exploradora" y vistas especiales conforme a las indicaciones derivadas de la historia, los hallazgos físicos y la primera película.

Se discute la anatomía del intestino delgado en relación con las alteraciones radiográficas.

Treatment of Epitheliomas of the Skin[1]

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THE POTENTIALLY high curability of basal-, squamous-, and basosquamous-cell epitheliomas of the skin is generally accepted, but there is a singular lack of unanimity of opinion as to the best means of achieving results. This paper presents the procedure which was worked out and used in the treatment of these tumors at the Ellis Fischel State Cancer Hospital, Columbia, Mo., and a statistical analysis of the results obtained in 492 patients treated there between September 1939 and September 1942.

One assumption forms the basis of the rationale of the method; namely, that either radiation or surgery, properly used, can cure any of these lesions. The support for the assumption lies in the large number of articles reporting almost equally good results from the use of each method. The widely varying technics of irradiation used by different workers, all again claiming favorable results, also indicate that there is little or no difference in radiosensitivity between the three types of tumor. The conclusion is that the histology of a lesion is no criterion for the choice of treatment. Rather should one base his selection upon the size and location of the growth, using that method which can be most effectively employed, which will give the best cosmetic result, and impose the least hardship upon the patient.

Inasmuch as this deduction holds good for almost no malignant skin tumors except the epitheliomas, accurate diagnosis is necessary. This can be established only by biopsy, and that procedure was carried out on all of the cases in this series.

The size of an epithelioma is the first factor to be considered in determining treatment. If it is less than 3 mm. in diameter, an adequate biopsy will remove practically all of the tumor. If the location of the lesion presents no contraindication to extension of the excision for another few millimeters, immediate excision should be done. It should, perhaps, be emphasized that in these instances the pathologist bears a responsibility for more than the diagnosis; he must examine the specimen in such a way as to determine whether the growth has been actually completely excised. If it has, there is no necessity for any further treatment. If not, re-excision or irradiation must be carried out. At the other extreme from these tiny lesions are the extremely large ones. Here, the combined knowledge and judgment of the radiologist and the surgeon may be taxed to the limit. These cancers have always destroyed large amounts of tissue and have usually involved bone. Bone invasion makes permanent arrest by radiation extremely difficult, if not impossible. On the other hand, complete removal of the lesion by surgery may mean creation of an irreparable defect which is incompatible with essential function or with life itself. In such a case, of course, one should attempt as much as can be accomplished with radiation and hope that the arrest will last for the duration of the patient's life. When surgical removal and plastic repair can be done, this is the method of choice, whether or not there is bone involvement, for tissues already damaged by radiation are unsatisfactory for reparative surgery, and radiation will not fill in a deficiency caused by the tumor itself. Epitheliomas of medium size, from 0.3 cm. to 3.5 cm., leave the physician free to choose that form of treatment which will give the patient the best cosmetic and functional result, and often allow him to consider even such items as convenience and expense.

[1] Presented at the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–6, 1946.

The location of the lesion usually provides the most important criterion. A few general rules may be briefly stated. If radiosensitive, important, contiguous structures cannot be protected, radiation is contraindicated. A narrow scar is preferable to a round, blanched area, but radiation, properly done, can usually produce results superior to those achieved by skin grafting of any type. The eye presents an excellent illustration of how important a matter of a few millimeters difference in location may be. When the tumor lies upon the bulbar conjunctiva or deep in the conjunctival fold, it is impossible to shield the globe and retrobulbar fat. Very small lesions in these locations can often be excised without damaging the eye, and the prosthesis employed immediately after enucleation of the eye for larger growths gives a far better appearance than a shrunken, heavily irradiated eye. The immediate treatment and post-treatment discomfort is also less with surgery. On the contrary, even tiny excisions along the lid margins produce defects. With the proper use of subpalpebral lead shields, growths of considerable size may be safely irradiated without damage to the eye and with little or no ultimate defect in the contour or function of the lid. At the canthi, surgery will almost inevitably destroy either the lacrimal gland or duct, both of which can usually be preserved by the use of radiation. On the hand, too, with its thin layer of tissue over the tendons and bones, slight differences in diameter or depth of lesions may lead to opposite decisions as to therapy. Only by the close collaboration of the surgeon and the radiologist can the basic rules be correctly applied to the multitudinous situations offered by individual cases.

In many instances, of course, neither size nor location forces a decision. The particular skills of the readily available practitioners may be of importance. The relation of the treatment schedule to the patient's daily routine sometimes may be allowed to dictate the course to be followed. Expense may also be of importance, for, while an ethical physician will always adjust his fee to the patient's means, there are certain ancillary costs which are not so flexible and which may prohibit one or another form of treatment.

Metastases should be treated by radical block dissection whenever possible. It is perfectly true that metastatic nodes may sometimes be controlled by radiation, but the percentage of successful results is considerably lower than when surgery is employed. The treatment must be intensive, resulting in severe radiation fibrosis of the treated area. In most instances, the node therapy should be entirely separate from that of the primary lesion and should be deferred. There are several reasons for this. The infection occurring in ulcerated carcinomas often gives rise to palpable nodes. It also complicates real node metastases. Thus, if the primary lesion is healed first, all node dissections become safer, and many contemplated operations will be found to be unnecessary. Finally, the futile treatment of metastases when the primary lesion cannot be controlled will be avoided.

Recurrent, or more properly persistent, primary lesions should usually be treated by some other method than the one originally employed. Those which persist after surgery usually do so because they are diffuse, infiltrating tumors the complete removal of which involves the excision of undue amounts of tissue; those still present after radiation are presumably radioresistant.

RADIATION TECHNIC

There is a strong tendency among radiologists to use large individual doses in the treatment of cutaneous epitheliomas. Many even resort to the single massive dose technic. This is understandable, for it is often difficult to convince the patient that daily treatments for two weeks are for his benefit and not simply to enrich the pocket of the radiologist. But it is not defensible. These tumors are cancers, and there is no more reason to disregard the teachings of Coutard in regard to protrac-

tion and fractionation than if one were dealing with a carcinoma of the larynx. A large percentage of long-term arrests, better cosmetic results, and fewer necroses will reward the patience of the careful therapeutist.

The kilovoltage should vary with the thickness or depth of the lesion. Most of the cases in this series were treated with 120 kv. and 140 kv. Lower voltages than these are safe only with the most superficial tumors, and the deep-tissue damage of 200 kv. is necessary only with the very deep ones. Additional filters from 3 mm. Al to 0.5 mm. of Cu were used with the appropriate kilovoltages, the machines all having inherent filtrations of 0.25 mm. Cu equivalent. The target-skin distances varied from 25 cm. to 50 cm. depending upon the thickness of the tumor and the kilovoltage. The fields were limited by means of cones and individually fitted lead cut-out shields. Around the eye, silver-plated lead shields were used under the lids and cut-outs over the outer surfaces.

At first, daily doses of 300 r and 400 r were used, but later experience showed that these were too high to give good cosmetic results with any but the smallest fields, and they were reduced. The final ordinary routine called for 200 r per day for the first 1,600 r, 300 r per day for the next 1,200 r, and 400 r per day for the last 800 r. These dosages varied with the size of the field, the kilovoltage, and the total dosage to be given. Some of the smallest tumors received as high as 5,000 air roentgens and a few of the very large superficial ones as little as 2,500 r. The aim should be always to get at least 3,000 tissue roentgens into the depth of the tumor.

Nearly one-third of the lesions were treated with interstitial radium. When hospitalization can be easily accomplished, this method has several advantages. From a theoretical standpoint it should be ideal, for it places the highest intensity of radiation at the growing base and edge of the tumor. Its rapid decrement of intensity can sometimes be used to advantage as a means of protecting underlying structures which cannot be shielded from direct external rays. Most important of its features is the saving in time. This may be extremely important for out-of-town patients, who may be treated in a matter of twenty-four hours with equally good therapeutic results and almost as good cosmetic results as would be accomplished with two weeks of x-ray therapy. Needles containing 3.3 mg. of radium per centimeter of active length or 5 mg. per cm. were used, the former taking an average of forty hours' treatment instead of the twenty-four hours required with the higher intensity. All of the needles had walls of 0.5 mm. of gold or platinum. Surface applicators were never used, because of the numerous difficulties involved in making and applying them and the absence of any therapeutic advantages.

TABLE I: TYPES OF LESIONS AND AGE OF PATIENTS

Patients	492
Lesions	760
Basal-cell	545 in 367 patients
Squamous-cell	197 in 154 patients
Basosquamous-cell	18 in 17 patients
Age	
Mean	70 years
Median	72 years

The surgery was done exclusively with the cold knife. Neither cautery nor the "electric knife" was used. Cautery destroys the specimen and also makes it impossible for the operator to know the depth to which he has gone. The round white scars are as bad as the worst radiation scars. The "electric knife" chars the tissues slightly, distorts the cell structure of the specimen, and again makes for unnecessarily prominent scarring. The supposed cancericidal action of the heat does nothing but give the operator a false and misleading sense of security.

STATISTICAL ANALYSIS

The mean age of the patients was seventy years and the median age seventy-two years (Table I). This is almost ten years older than the patients in most other series and accounts for the large number of deaths from intercurrent disease. Treatment facilities having been brought to the indigent rural population for the first time with the

TABLE II: ANATOMICAL DISTRIBUTION OF LESIONS

Location	Basal-Cell	Squamous-Cell	Baso-squamous-Cell
Scalp	6	...	..
Forehead	29	7	1
Nose	108	14	4
Ala nasi	17	...	..
Cheek	183	88	4
Upper lip	5	1	..
Lower lip and chin	20	4	..
Upper eyelid	11	1	..
Lower eyelid	20	2	..
Inner canthus	21	3	..
Outer canthus	8	1	..
Conjunctiva	...	...	1
Ear, pinna	27	27	3
Neck	59	29	5
Trunk	18	...	..
Arms	8	2	..
Wrist	...	2	..
Hand and fingers	2	14	..
Legs	3	2	..
	545	197	18

opening of the hospital, the proportion of far advanced, often hopelessly advanced, lesions received during the first year was discouragingly high. Later material approximated in quality that seen in most large clinics. Forty-six patients had more than one kind of lesion, and 139 had multiple lesions of the same kind. The anatomical distribution of the lesions is detailed in Table II.

The final results of the whole material are shown in Table III and of the basal- and squamous-cell lesions separately in Table IV. The figures in the second column of Table III and the second and fifth columns of Table IV are absolute percentages. Those in the third and sixth columns are calculated. Various schemes have been proposed to adjust the cure rate in skin tumors to compensate for the high percentage of loss from intercurrent disease before the end of the follow-up period, and thus to bring the figures more nearly into line with the computed cure rates of cancer occurring in the earlier decades of life. Magnusson (1) chose to apply his known recurrence rate to the number of patients dying of intercurrent disease, counting the resultant number as dead of disease and adding the remainder to his known "living and well." Warren (2) objects to this use of hypothetical cures. Instead, he applies the current general mortality rate for a population of the same age group to his total number of patients and computes his final cure rate upon this number of calculated survivors instead of upon the original number of patients in the series. Both methods have been used here and the results entered with the letters M and W in parentheses. Curiously, higher computed rates are obtained in this series by means of Warren's method than with Magnusson's.

TABLE III: THREE-YEAR RESULTS FOR ENTIRE SERIES

	No. Patients	Percentage of All Patients	Percentage of Survivors (Calculated)
Living free of cancer	327	66.4	88.6 (W) 83.3 (M)
Living with cancer	5	1.2	
Dead of cancer	43	8.7	
Lost to follow-up	28	5.6	
Dead of other diseases, free of cancer	89	18.1	

In Table V the results, both absolute

TABLE IV: THREE-YEAR RESULTS FOR BASAL-CELL AND SQUAMOUS-CELL LESIONS

	Basal-Cell			Squamous-Cell		
	No. of Patients	Per Cent	Per Cent of Survivors (Calculated)	No. of Patients	Per Cent	Per Cent of Survivors (Calculated)
Total	367	100		154	100	
Living free of disease	235	64	85.6 (W) 87.2 (M)	92	59.7	80.9 (W) 75.3 (M)
Living with disease	3	0.8		2	1.3	
Dead of disease	18	4.9		25	16.2	
Lost to follow-up	19	5.2		9	5.8	
Dead of intercurrent disease	92	25.1		26	18.2	

TABLE V: THREE-YEAR CURE RATES, COMPARED WITH RESULTS AT RADIUMHEMMET

	Three-Year Cure Rates		Calculated Three-Year Cure Rates	
	Our Series	Radium-hemmet	Our Series	Radium-hemmet
Whole material	66.4	73.6	83.3	86.0
Basal-cell	64.0	81.6	87.2	93.2
Squamous-cell	59.7	60.1	75.3	77.5

and computed, are compared with Magnusson's figures from Radiumhemmet, Stockholm. After adjustment for the higher losses from intercurrent disease in our series, there are no statistically significant differences.

The relative merits of several forms of treatment can be compared on a survival basis only if each treatment has been applied indiscriminately to consecutive cases and if the disease is one which carries a high direct mortality. Such is not the case in this series. The methods of treatment were carefully selected according to the criteria just described. Secondly, these epitheliomas cause death directly only after extremely long periods of neglect, and even then only in a low percentage of the patients. Recurrence, on the other hand, will inevitably occur if the treatment is improper, and 95 per cent of the recurrences will be apparent within three years. Table VI shows the recurrence rates for all

TABLE VI: COMPARISON OF RECURRENCES WITH THREE METHODS OF TREATMENT

Therapy	Basal-cell, No. Cases	Recurrences	Squamous-cell, No. Cases	Recurrences
X-ray	333	17 (5.1%)	97	4 (4.1%)
Radium	163	8 (4.9%)	72	3 (4.2%)
Surgery	49	1 (2.0%)	28	3 (10.7%)

three forms of treatment and for lesions of both major types. The basosquamous lesions were too few to have any significance and were omitted. It is immediately seen that there is no real statistical difference. The seemingly bad results from surgery of the squamous-cell lesions are illusory. This group is small and contains 11 lesions of the hand and wrist, several of which had massive axillary metastases when first seen. Two of the three recurrences took place in the stumps after amputation in these cases.

SUMMARY

A treatment plan is presented for basal-, squamous-, and basosquamous-cell epitheliomas of the skin in which the choice of the method of treatment is based primarily upon the size and location of the lesion, secondarily upon the probable cosmetic result, and not at all upon the histology. Biopsy is advocated to insure that the lesion belongs in the epithelioma group. The size and location are considered important because they affect the efficiency with which radium, x-rays, and surgery may be used.

Seven hundred and sixty lesions were treated on 492 patients in three years. At the end of a minimum three-year follow-up period, 327 patients (66.4 per cent) were living free of disease and 89 (18.1 per cent) had died of other diseases. When Magnusson's correction factor for those dying of intercurrent disease is inserted, the cure rate becomes 83.3 per cent, which compares favorably with the Radiumhemmet rate of 86 per cent. The results of the three methods of treatment are compared by using the recurrence rate as the basis, and again no statistically significant differences are observed.

NOTE: I am deeply indebted to my friends and former colleagues at The Ellis Fischel State Cancer Hospital for permission to use this material and for their generous assistance in compiling the data.

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DISCUSSION

J. A. del Regato, M.D. (Columbia, Mo.): After listening to Dr. Eberhard, one cannot but be captivated by his logic. I have examined and followed hundreds of patients treated by him at The Ellis Fischel State Cancer Hospital, and consequently I have had an unusual opportunity to appreciate his excellent results in the treatment of carcinomas of the skin.

I agree with Dr. Eberhard that the histologic character of carcinomas of the skin does not offer a basis for choice of treatment. I would like to add, specifically, that the reputed radioresistance of the *adenoides cystica* type of carcinoma is a myth. I also agree that invasion or proximity of cartilaginous or bony structures is not a contraindication to radiation therapy, but only a circumstance requiring special adaptation of technic. I also agree that surface curietherapy has no special virtues, but, unlike Dr. Eberhard, I extend the same consideration to include the interstitial application of radium. There can be no question as to the ability to control carcinomas of the skin by skillful interstitial curietherapy, but the cosmetic results can be improved and a number of cases of radiodermatitis avoided when adequate roentgen therapy is substituted.

We hold the opinion that adequate roentgen therapy is the treatment of choice of carcinomas of the skin; the size of the lesion and its location will determine the quality of radiation needed, the maximum daily dose administered, and the required protraction. The minimum total dose which is necessary to sterilize the tumor will vary with the size of field, the quality of radiations, and the average daily dose. This implies a diversity of technics to be applied to the different cases and forbids routine methods. We give preference to surgical treatment in certain instances where it accomplishes effectively and expeditiously what would require more time and attention by means of roentgen therapy. Lesions of moderate size of the skin of the cheeks and cervical regions may be widely excised without disfigurement; carcinomas of the scalp and dorsum of hands are very adequately treated by excision and skin grafts. In general, surgical treatment is most practical in the rare carcinomas of unexposed areas of the skin. That we give preference to the surgical treatment of these lesions does not mean that roentgen therapy is contraindicated. The surgical treatment of carcinomas of the dorsum of hands by excision and skin graft is very satisfactory, but when the surgical excision implies mutilation, roentgen therapy should be first considered. Very often, the clinical assumption of invasion of tendons of the hand is not verified on microscopic examination of the surgical specimen; the adherence in depth and resulting dysfunction is more often due to underlying inflammation (Ackerman). In such cases an amputation may not be justified and protracted roentgen therapy is the treatment of choice. In the treatment of carcinomas of the eyelids, of the inner and outer canthus of the eye, of the skin of the ear, of the preauricular and retroauricular regions, of the skin of the nose, and of extensive lesions everywhere, the suppleness of roentgen therapy, its adaptability to the peculiar requirements of the lesion or of the region, cannot be excelled by any other method.

In the present state of our development in the treatment of cancer, a skillful performance is often more important than the choice of method. I am in complete agreement with Dr. Eberhard in respect to the results obtainable by roentgen therapy. But, although I am witness of the excellent results which he has obtained with interstitial curietherapy, I feel that I would be incapable of reproducing these results by the same means, and I remain convinced of the universal virtues of roentgen therapy in carcinomas of the skin.

Henry J. Ullmann, M.D.: I am interested particularly in these statistics of curability, for I think I shall have to go back and review the cases that I reported before this Society about two years ago, and which were published in RADIOLOGY (**46:** 279, 1946) within the last year, on a comparable number of lesions with a somewhat higher percentage of good results. In my locality I get a higher percentage of patients in the lower age group. I have quite a number in the forties, and they are common in the fifties. Of course, in Southern California we have a fairly dry climate and considerable sunlight. I have treated the majority of my cases with roentgen rays and a few with radium.

I concur heartily with the warning that it is extremely dangerous to treat over bone, especially over the hands and wrists. I have had some unfortunate results in these areas with radiation of any type. On the scalp I usually treat by surface applications of radium with heavy filtration, and with the applicator fairly close to the lesion to reduce the depth dose and injury to the underlying bone. The results of this method have been very satisfactory. I should hesitate to use the roentgen ray with what I call a cauterizing dose on the scalp.

Theodore P. Eberhard, M.D. (*closing*): I must apologize first for having somehow or other missed Dr. Ullmann's paper in my review of the literature.

On the matter of late radiation necrosis, I think that further analysis of this series, which I did not have time to complete, will show a considerably lower percentage than Dr. Ullmann mentioned, and that is one of the reasons that I believe in this type of therapy. The multiple series type of treatment I believe is what contributes to the later necrosis.

Dr. Ullmann: I use the long-protracted procedure only with the higher voltage. The time is three weeks with the copper filter. I take only a week with the lower voltage.

Dr. Eberhard: I agree to higher voltages for the thicker lesions. I seldom go down to 100. I think the failures result from too low voltage, underestimating the thickness of the lesion.

SUMARIO

Tratamiento de los Epiteliomas Cutáneos

Preséntase un plan terapéutico para los epiteliomas baso-, escamo-, y basoescamosocelulares de la piel, en el cual la elección del método de tratamiento se basa primordialmente en el tamaño y localización de la lesión y secundariamente en el probable efecto estético, sin tomar en cuenta la histología. Se recomienda la biopsia para cerciorarse de que la neoplasia pertenece al grupo epiteliomatoso. El tamaño y la situación se consideran importantes por afectar la eficacia con que pueden utilizarse el radio, los rayos X y la cirugía.

En tres años tratáronse 760 lesiones en 492 enfermos. Al cabo de un período mínimo de tres años de observación subsiguiente, 327 enfermos (66.4 por ciento) se hallaban vivos y sin enfermedad y 89 (18.1 por ciento) habían fallecido de otras enfermedades. Al aplicar el factor de corrección de Magnusson para los que mueren de afección intercurrente, el coeficiente de curación pasa a 93.3 por ciento, que se compara favorablemente con el 86 por ciento del Radiumhemmet. Al comparar el resultado de los tres métodos terapéuticos, tomando como base el índice de recurrencias, tampoco se observan mayores diferencias estadísticas.

A Grid-Front Cassette

A Useful Application of the Stationary Grid

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Section on Roentgenology, Mayo Clinic, Rochester, Minnesota

SINCE THE introduction of the stationary grid for roentgenographic purposes, roentgenologists have found the device useful in circumstances in which a conventional Potter-Bucky diaphragm cannot be employed. The use of the stationary grid in many instances, however, has been complicated by a difference in the size of the grid unit and the various cassettes available. When the grid is used in the vertical position, various makeshift devices, such as sandbags, adhesive tape, clips, etc., have been necessary to hold the grid in apposition to the cassette.

To overcome this difficulty and obtain a grid-cassette combination that could be placed quickly in all positions, it was felt that the grid should be an integral part of the front of the cassette. This was achieved by removing the bakelite front of a Picker cassette and replacing it with a metal Lysholm grid cut to corresponding size. The front of the metal Lysholm grid was protected by a thin bakelite or plastic sheet. Because of the thinness of the Lysholm grid, the combined thickness of the grid and protective sheet was the same as the bakelite front that had been removed. The result was a grid-front cassette which was the same size in all dimensions as a conventional cassette (Fig. 1). This combination has many advantages that are readily apparent. The detail of the resulting roentgenogram is improved, the shadows of the grid lines are narrower because of lessened distortion, and the cassette because of its standard size can be used in any cassette tunnel or stereoscopic shift device.

A similar grid-front cassette has been made for use of the roentgenologists at the Mayo Clinic by replacing the bakelite front of a standard Kelley-Koett cassette with a Liebel–Flarsheim stationary grid and protecting bakelite front.[1] The result was a unit similar to that first mentioned but about 1/8 inch (0.32 cm.) thicker than the standard cassette. This disadvantage can be eliminated by a slight change in the design of the cassette. Any other cassette likewise can be adapted to this purpose. Because of the difference in construction of the Lysholm and Liebel–Flarsheim grids, there is a difference in the quality of the resulting roentgenograms that in my experience favors the metal grid.

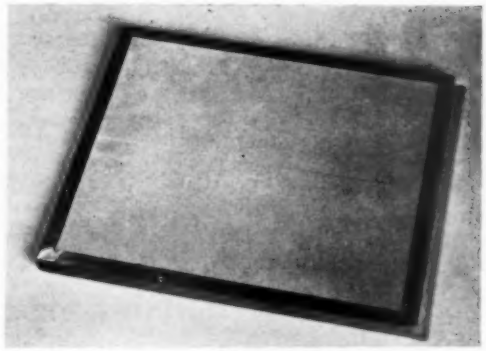

Fig. 1. Grid-front cassette. A metal Lysholm grid and protective plastic covering have been substituted for the conventional bakelite front of the cassette. The resulting grid-cassette unit is of the same size and thickness as the original cassette.

My colleagues and I have used these grid-front cassettes for nearly a year and are frequently finding new applications for them, since they can be made in any standard size. They have become indispensable for bedside examination of structures that normally would require a Potter-Bucky diaphragm. Excellent bedside roentgeno-

[1] Since this article was prepared, I have been informed that Dr. James P. Rousseau of Winston-Salem, N. C., utilized a special Liebel-Flarsheim grid-front cassette for examinations of the hip several years ago.

grams of the skull, chest, spinal column, pelvis, urinary tract, etc., are now easily obtained. In the operating room the grid-front cassette has proved most desirable in the examination of fractured hips and for cholangiograms. It is used routinely for certain projections during encephalography, ventriculography, and other special examinations. Since the grid-cassette unit may be used in any cassette shifter, it permits the production of roentgenograms of the Potter-Bucky type when a high-speed vertical type of Bucky unit is not available. For special examinations, such as arteriography, angiocardiography, and others in which a rapid sequence of exposures is desirable, the use of the grid-cassette unit eliminates the time lag that occurs when the conventional Potter-Bucky mechanism is employed.

A disadvantage of the grid-front cassette is its relatively high cost; however, others who have had an opportunity to use the device have stated that its usefulness more than compensates for that.

Section on Roentgenology
Mayo Clinic
Rochester, Minn.

SUMARIO

Chasis con Rejilla por Frente

Quitándole el frente de bakelita a un chasis o cassette y reemplazándolo con una rejilla y recubrimiento plástico como resguardo, se ha obtenido un chasis-rejilla del mismo tamaño y espesor que el primitivo y que ha encontrado numerosas aplicaciones en radiografía.

EDITORIAL

A Total Population Chest Survey

In view of the importance to radiologists of the proposed campaign of the National Tuberculosis Association urging every one in the United States to have an x-ray examination of the chest, RADIOLOGY has deemed it expedient to publish, with a few minor omissions, the following correspondence between Dr. Francis J. Weber, Medical Director Chief, Tuberculosis Control Division, U. S. Public Health Service, and Dr. L. Henry Garland, President-Elect of the Radiological Society of North America.

WASHINGTON 20, D. C.
Aug. 20, 1947

Dr. L. Henry Garland
450 Sutter Street
San Francisco 8, Calif.

DEAR DR. GARLAND:

As you may know, the National Advertising Council has accepted the proposal advanced by the National Tuberculosis Association to put on a campaign starting after the first of the next calendar year urging the people of this country to have chest x-rays. The proposal was accepted because it was the feeling of the Advertising Council that specific action could be urged on the public, leading toward ultimate public benefit.

The advertising agency...selected to handle the preparation of the material is now at work... The National Tuberculosis Association and the United States Public Health Service are serving as sponsoring consultants to this agency. It is planned that the final material will urge the public to consult physicians, tuberculosis associations, and health departments with respect to obtaining chest x-rays. This general material will be supplemented by material which can be adapted to local area use so that programs as developed locally may tie in with the national campaign. The National Tuberculosis Association at its last annual Board meeting voted to underwrite the preparation of the materials.

It is hoped that this campaign will receive the active support of the medical profession, particularly the organized groups such as the Radiological Society of North America, the American Roentgen Ray Society, the American Medical Association, as well as the two groups specifically interested in diseases of the chest, the American Trudeau Society and the American College of Chest Physicians....

If this concept of an approach to the public on a public health problem is consistent with your thoughts, I should like to enlist your active support of the program among the officers and members of the professional organizations.

Particularly, you can do much to advance the program because of your position of recognized leadership in your field, as shown by your election to the presidency of the Radiological Society of North America.

Sincerely yours,
FRANCIS J. WEBER

SAN FRANCISCO 8, CALIF.
Aug. 28, 1947

Francis J. Weber, Medical Director
Chief, Tuberculosis Control Division
U. S. Public Health Service
Washington 25, D. C.

DEAR DR. WEBER:

This will acknowledge your letter of Aug. 20....

Several years ago, the American College of Radiology, in formally approving the principle of mass chest surveys for the detection of pulmonary tuberculosis, emphasized that: "Films should be examined by physicians who are trained and competent to interpret radiographs of the chest."

Frankly, this appears to be the crux of the problem. You state that the National Tuberculosis Association will urge all persons to have "chest x-rays"...which may mean nothing. Having a chest x-ray is valueless unless it is properly interpreted.

How and where should we direct persons so that they may receive a reliable x-ray examination?

Should we urge them to be examined by qualified physicians in their offices?

Should we direct them to certified radiologists (names are obtainable from most local county medical societies)?

If directed to other than certified radiologists, should we set up standards to protect the public? A chest x-ray at a Tuberculosis Unit or a Public Health Depot may be read by an unknown reader, qualified or otherwise. Should we insist on tested readers for all survey centers, mobile units, etc.?

Should we notify them that (*a*) minimal pulmonary tuberculosis may be missed even on a large film and (*b*) that, strictly speaking, the diagnosis of tuberculosis always requires sputum confirmation? Therefore, such examination may also be required.

As long ago as 1941 the San Francisco Roentgen Society presented a proposal for a total population survey (for that city) to the San Francisco County Medical Society, the local Tuberculosis Association, and the Department of Health. An x-ray survey unit was set up in a central location and a significant number of the citizens have been examined to date. Owing to the war, the problem of testing readers had to be deferred. I regret to say that since return from service I have not yet been able to persuade the local tuberculosis or other officials to resume attempting its solution.

It would seem to me that the U. S. Public Health Service and the National Tuberculosis Association should *first* work out some simple and fairly reliable method of *testing* "*readers*" before embarking on any *total* population chest survey. This would tend to obviate what happened in one large county in California a few years ago; the local Tuberculosis Association conducted a mass chest survey on young persons and had the films "read" by local practitioners. The latter diagnosed some 40 per cent of the cases as positive for childhood tuberculosis!! On having the films properly interpreted by two radiologists in Los Angeles, this percentage was reduced virtually to zero. You are also doubtless familiar with the large western state in which some 35,000 miniature films were made a few years ago and were never read at all!!

Would it be possible to postpone the proposed advertising campaign for some months in order that there might be set up suitable regional testing centers where potential film readers (internists, radiologists, or others) might be tested? Further, in case survey units are employed, could you set up some method for technical supervision by certified radiologists so that the technical aspects of the program could be watched, and only films of the highest caliber produced? Sponsored by national authorities, supervised by certified radiologists and interpreted by tested readers you would have a mass chest survey which would really mean something. As Lanza observed (J. A. M. A., 6.30.45), "Tuberculosis survey work should be conducted along medical lines, through a medical approach, and with interpretation by those who are capable of interpreting the films."

Preliminary to the above, some publicity concerning the program could be released. Perhaps the Report of the Council on Industrial Health of the A. M. A. on the question of mass health surveys could be reprinted and widely circularized (especially items 1 to 5—see J. A. M. A., 8.11.45). Finally, to gain support of the medical profession at large, would it be wise to note that expert legal counsel has expressed the opinion that chest surveys, involving as they do a diagnostic procedure, constitute the practice of medicine and should be treated accordingly?

These are knotty questions; upon their fair solution, the success of the program may well depend.

Yours sincerely,
L. H. GARLAND, M.D.

WASHINGTON 25, D. C.
Sept. 12, 1947

Dr. L. H. Garland
450 Sutter Street
San Francisco 8, Calif.

DEAR DR. GARLAND:

I have your letter of August 28th and I wish at the very outset to thank you for it. This obviously well-thought-out missive of yours is an accurate presentation of the general problem of routine chest x-ray.

I also wish to acknowledge, in the beginning, that there are no things in the picture you presented which are contrary to any views held by us. Actually, we are in close agreement with all of your points and all that I can offer in reply is added explanation of how the advertising program came about and, at the same time, discuss some of the important things which led to our co-operation with the Council.

As you know, the Advertising Council is a non-profit group supported by the nation's industrial leaders and businessmen. It has no direct or indirect connection with the government and indeed pursues policies quite independent of any governmental agency. Since advertising has been so successful in many fields and inasmuch as it is really a part of our national life, these men, through purely philanthropic motives, feel that by placing this effective public instrument at the disposal of medical leaders, it will be possible to use it in ways to promote better individual and community health. Since all of us as physicians have health conservation uppermost in our minds, we felt very kindly to this offer....

While it is true that we can only proceed on a reduced scale at this time because of certain limitations which you have pointed out (limitations which are also appreciated by us), we still feel that much can be done as a start in this important field.

You will be interested in knowing that executives of this Council told me of formal requests from twenty different health organizations asking them to sponsor their respective health programs. After considering each one carefully they felt that the opportunities for doing good, even though limited as they are, would be best in an attack on tuberculosis....

It still remains to be answered as to how the program should be conducted, making certain that the best interests of the public are served. Here I think we should rightly insist, as you have emphasized, that chest films be interpreted only by those who are competent to interpret them....

Now as to a training program for interpreters. In regard to this, let me say that I admire very much the plan that you, in conference with others, worked out sometime ago in San Francisco. It is too bad that this plan had to be curtailed as a result of the war. However, now that the war is over, I think such a thing could be taken up again, worked out so that it is practical for a large part of the country, and then publicized in the right channels to see that such a program is set up in as many places as possible. In this we will have to rely on the educational efforts of societies like yours, because (frankly) we do not have the personnel or the funds with which to conduct a nationwide program of that type. We realize it is something to be done, however, and it seems that the best that should be done at this time would be to start it in one or two areas like yours, determine the most practical way of going about it, and attempt to get the funds from some place to make it possible to have similar programs in different parts of the country. One way to do it, for example, would be for the roentgen-ray societies to get together with, let us say, the Medical Section of the National Tuberculosis Association, namely, the Trudeau Society, and work out some program much like the present post-graduate type of conference being held at different parts of the country. This is something which I feel such professional groups can do better than we ourselves who are in official work, although we are in a position to help such groups organize it and even do some of the work. Certainly we are anxious to help.

With regard to the possibility of postponement of the proposed advertising campaign, I feel sure that plans are too well advanced to consider such a move. As a matter of fact, the Council wanted to go ahead last year but were deliberately discouraged. It was decided to go ahead, however, this next January, with the program to begin quite slowly at first, the full effects not to be felt for several months. Therefore, there is still nearly a full year for planning, as well as an opportunity to observe the program and determine what the fresh demands of this new program will be.

This subject is such an important one...that it would seem well if some of our staff could discuss this at your next annual meeting. At that meeting, I would hope to get not only the views of the Society regarding the desirability of this program from a control point of view, but I would also like the Society's assistance in developing some workable plan by which we could better handle an increased load of routine x-rays that might result from this advertising program. I think if we start in now, sound plans can be laid for the future. I might say that the Advertising Council will consider renewing the drive at the end of the next calendar year should the first year's efforts promise success. Therefore, as you see, we actually have the time to plan the things which you have suggested in your letter. Certainly we will want to work as closely as possible with such an important public spirited group as yours and I hope it will be possible to follow through on my suggestion that it be taken up at your next annual meeting.

Sincerely yours,
FRANCIS J. WEBER

SAN FRANCISCO 8, CALIF.
Sept. 23, 1947

Francis J. Weber, M.D.
Tuberculosis Control Division
U. S. Public Health Service
Washington 25, D. C.

DEAR DR. WEBER:

Thank you for your letter of Sept. 12th. After consulting with several radiologists throughout the United States, it is still our opinion that the best way of achieving the goal of a total population survey would be to set up a sound procedure first, and then to publicize it. In any event, most radiologists would welcome specific assurance of the U. S. Public Health Service and the National Tuberculosis Association on the following points:

1. Only qualified personnel will be used to supervise the technical procedure and make the interpretations of the survey films. Each county medical society will be asked to designate a list of qualified physicians who would be available in that district.

2. The U.S.P.H.S. and the N.T.A. will secure approval by each local county medical society before any survey center is established or utilized in this program.

3. A definite suggested procedure for the handling of cases which have abnormal shadows will be outlined, presumably with emphasis on regular medical and x-ray examination, sputum studies, *and* follow-up.

We note in your recent letter that the proposed advertising campaign has been postponed once. Should not this be renewed in order that plans for correct procedure might be completed before the public is approached? As the London Letter to the J. A. M. A. (10.21.44) put it in part: "Anything that would weaken public confidence in mass radiography would impair its usefulness. So also would anything that would lead the public to expect too much from this method. Mass radiography has not made the diagnosis of pulmonary tuberculosis easier; on the contrary, it brings to light many symptomless cases.... As the diagnosis of tuberculosis may involve change or loss of work and prejudice life insurance, it should be made only by persons with all the diagnostic procedures at their disposal."

Yours very truly,
L. HENRY GARLAND, M.D.

PENNSYLVANIA RADIOLOGICAL SOCIETY

At the 32nd Annual Meeting of the Pennsylvania Radiological Society, held May 9 and 10, 1947, at Pocono Manor, the following officers were elected to serve for 1947-48: Ralph D. Bacon, M.D., Erie, President; Leslie H. Osmond, Pittsburgh, President-Elect; George W. Chamberlin, M.D., Reading, 1st Vice President; William V. Dzurek, M.D., Pottsville, 2nd Vice President; James M. Converse, M.D., Williamsport, Secretary-Treasurer; Samuel G. Henderson, Pittsburgh, Editor; Paul G. Bovard, M.D., Tarentum, Associate Editor; William E. Reiley, M.D., Clearfield, Editor Emeritus.

The 33rd Annual Meeting of the Society will be held at Erie, May 21 and 22, 1948, with headquarters at the Hotel Lawrence.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

TEMPOROMANDIBULAR ARTHROGRAPHY. By FLEMMING NØRGAARD. A volume of 188 pages and 31 plates, with 132 figures. Published by Einar Munksgaard, Copenhagen, 1947.

Book Reviews

CANCER: DIAGNOSIS, TREATMENT, PROGNOSIS. By LAUREN V. ACKERMAN, M.D., Pathologist to the Ellis Fischel State Cancer Hospital; Assistant Professor of Pathology, Washington University School of Medicine, St. Louis, Mo., and JUAN A. DEL REGATO, M.D., Radiotherapist to the Ellis Fischel State Cancer Hospital; former Assistant to the Radium Institute of the University of Paris. A volume of 1,200 pages, with 749 illustrations, 42 in color on nine plates. Price $20.00.

The authors of this new treatise on the subject of cancer are the pathologist and radiotherapist, respectively, in the State Cancer Hospital of Missouri, and the contents reflect their experience in the field of malignant neoplastic disease.

The book is divided into two parts, the first of which includes an introductory chapter, a chapter on Cancer Research by Dr. Michael Shimkin of the National Cancer Institute, and chapters on Pathology, Surgery, and Radiotherapy. This material is of a rather general nature and does not by any means encompass all of the available information on the subjects discussed. It does, however, constitute a good readable summary of important phases of the cancer problem, furnishing a background for the later chapters.

Evidently through an oversight, the heading of Part II has been omitted, but this obviously begins with Chapter VI, on Cancer of the Skin, which is followed by thirteen chapters dealing with the other anatomical systems of the body and two final chapters on Hodgkin's Disease and Leukemia. The chapters are subdivided according to organs. In the chapter on the Digestive Tract, for example, there are sections on the esophagus, stomach, small bowel, appendix, large bowel, anus, salivary glands, pancreas, liver, gallbladder, and extrahepatic ducts and periampullary region. Cancer in each of these sites is discussed under the further subdivisions: anatomy incidence and etiology, pathology, clinical evolution, diagnosis, treatment, and prognosis, and this plan is followed throughout the book. Each chapter has its own list of pertinent references.

In their preface the authors are at some pains to explain the nomenclature which they have adopted. The word *cancer* at the heading of any chapter indicates that malignant tumors of different origin are included; *carcinoma* is used as a heading when only malignant epithelial neoplasms are considered, and the rarer tumors of the same area are treated in the section on differential diagnosis; finally, the word *tumor* has been chosen as a heading whenever the frequency or the seriousness of the benign tumors, the difficulties of differential diagnosis of benign and malignant tumors, or the importance of the treatment which is indicated in either case justifies a joint consideration.

Dr. Ackerman and Dr. del Regato have filled a long felt need for a treatise not only on the general subject of cancer but one that contains authentic information on radiotherapy, a subject that too often has been disposed of in a few short paragraphs. The clinical descriptions and the pathologic studies will also be found helpful. This volume should prove of value to the student who is interested in cancer, and to the surgeon and radiologist who have a common problem in its management and cure.

OSTEOTOMY OF THE LONG BONES. By HENRY MILCH, M.D., Consulting Orthopedist, Maimonides Hospital: Attending Orthopedic Surgeon, Hospital for Joint Diseases and Riverside Hospital, New York; Fellow of the American Academy of Orthopedic Surgeons, the American College of Surgeons, and the New York Academy of Medicine. A volume of 294 pages, with 181 illustrations. Published by Charles C Thomas, Springfield, Ill., 1947. Price $6.75.

For some years, Dr. Milch has described with enthusiasm the correction of deformities and the improvement of function brought about by altering

the shape and continuity of the long bones. Numerous exhibits at surgical meetings have testified to his interest and experience. He has now crystallized his past efforts into one readable volume which covers all details of the subject in an orderly manner.

Included in this work are the mathematical considerations and bases for correction of deformity by osteotomy. Special attention is given to preoperative plans to determine the proper amount of correction to be made, thus avoiding the pitfall of careless surgery. It is emphasized that an osteotomy requires precision and must be well planned in advance.

The discussion of upper extremity osteotomies, generally performed less frequently than osteotomy in the lower extremity, is a valuable part of Dr. Milch's book. Leg lengthening and leg shortening by osteotomy and epiphyseal arrest are considered at length. Of particular interest are the chapters dealing with types of hip and upper femoral osteotomies promulgated by various authors. Here the methods are outlined in detail, and their advantages and disadvantages are pointed out.

This book is not for the student or neophyte, but is an excellent volume for the orthopedist and is useful as a reference work to which one may turn for aid in the intelligent management of a difficult surgical problem. The more one uses osteotomies the more evident are their advantages in favorable cases. It is hoped that this work will popularize the use of this corrective procedure.

ACTIONS OF RADIATIONS ON LIVING CELLS. By D. E. LEA, M.A., Ph.D., Prophit Student of the Royal College of Surgeons, Formerly Fellow of Trinity College, Cambridge. A volume of 402 pages, with 83 tables, 4 plates, and 61 figures. Published by Macmillan Company, New York, 1947. Price $4.50.

The late D. E. Lea has written a much needed book, but one whose scope is much more limited than the title implies. It is confined to the author's own interpretation of the target theory of the action of ionizing radiations on biological material. An introductory chapter deals with the physics of ionizing radiations, giving useful calculations and tables on the dissipation of energy of x-rays, protons, and alpha particles. The second chapter discusses chemical effects largely in terms of OH and H radicals produced. Although effects on enzymes are considered, it is surprising to find no discussion of effects on proteins or organic and inorganic colloids, particularly since a considerable amount of work has been done with such systems and the results have been used in the interpretation of induced chromosome alterations, to which a goodly portion of the book is devoted.

The target theory is developed in considerable detail. The methods for calculating target volume used by previous investigators are presented together with a more general method developed by the author which is not subject to the limitations of the earlier procedures. Useful tables and graphs are given for calculating target size from dose-response data. Analysis of results with phage and virus in general agree with expectations from theory. However, although the fit is good in the case of alpha particles, it is poor with x-rays of 0.15 Å. The results with the larger phages may be explained by assuming that, unlike the viruses, they contain an appreciable amount of insensitive material and have a number of targets rather than a single one.

Induced rates of visible mutations per roentgen in virus, bacteria, and *Drosophila* are of the same order of magnitude, and are independent of intensity and wave length in the range 0.01–1.0 Å. However, at the w-eye color locus the rate of induced mutation from wild type to w^x is 13 times greater than the rate for white eye to w^x, which the author does not discuss. In the production of mutations, neutrons are less efficient than x-rays, and alpha particles less efficient than neutrons. From these observations the author deduces that a single ionization suffices to produce a mutation. Dominant lethals are also discussed in relation to chromosome aberrations, and evidence is furnished in support of the theory that recessive lethals are rejoined chromosome breaks.

By analogy with viruses, where the ratio of target to molecular size is known, the author computes the minimum gene size from the frequency of gene mutation per roentgen. From the relative efficiencies of x-rays, neutrons, and alpha particles in producing lethal mutations a gene target diameter of the same size (2–9 $m\mu$) is obtained. This is also the order of magnitude of the diameter of the chromosome sensitive volume obtained by methods not described by the author.

The greatest portion of the book is devoted to analysis of induced chromosome changes, but space will not permit a thorough discussion of the author's presentation and analysis. In developing his theory as it relates to chromosome aberrations, he has selected some sets of data and discarded others. Sometimes no reason for the selection is given, while in other cases data are discarded with a merely perfunctory statement which contrasts strangely with the thoroughness of the analysis in other portions of the book. The analysis and conclusions are based almost entirely on results obtained with *Tradescantia*. Chromosome exchanges are considered to vary as a function of the square of the x-ray dose and neutrons are found to be more efficient than x-rays in producing structural chromosome changes. Distinction is made between "structural" and "physiological" chromosome alterations and the relative neutron and x-ray efficiency for producing each, which fit the author's hypothesis but which to the reviewer seem entirely unsupported by the actual observations.

Exchanges are not at random, but analysis requires that exchange partners be separated by no

more than 1 micron. The number of initial or primary breaks per roentgen calculated by three different methods is found to give good agreement. An alpha particle or proton passing through a chromatid will produce a break but only the end of the beta track has the same probability of producing a break.

Lethal effects in various organisms and inhibition of mitosis are also discussed.

In spite of such shortcomings as have been mentioned, this is a very stimulating and useful book. Much information from a variety of biological disciplines as well as from physics and chemistry has been assembled and interpreted in support of the author's thesis. The result in penetration as well as scope is a commendable achievement.

EL TORAX RADIOLÓGICO DEL NIÑO EN LAS ENFERMEDADES INFECTO-CONTAGIOSAS. By RODOLFO E. TISCORNIA, M.D., Roentgenologist of the Pedro Visca Hospital of Montevideo, Uruguay. A volume of 138 pages, with 37 illustrations. Published by Espasa-Calpe, Argentina, 1945.

In this small volume, the author describes, on the basis of a group of cases in children up to 13 years of age, the roentgenologic aspects of the thorax in whooping cough, measles, diphtheria, influenza, typhoid fever, chickenpox, mumps, and scarlet fever. These descriptions are preceded by two introductory chapters and one dealing with the normal and pathological anatomy of the lungs in children, with special reference to the hilus, the fissures, and the bronchial distribution.

The author points out, that, while there is nothing really specific in the roentgen images of the thorax in the diseases under consideration, there are certain characteristics which may "suggest" their presence. The main interest of the book lies in the review of all possible thoracic findings in children suffering from the diseases mentioned, the comparison of the roentgen images, and the effort to group these alterations, if not into a specific picture, at least, to use the author's own words, into something that "looks familiar."

LA TOMOGRAFIA, NELLE MALATTIE DEI SENI PARANASALI. CONTRIBUTO CLINICO RADIOLOGICO. By ENRICO BOZZI, Docente, Primario di Otorinolaringoiatria dell'Ospedale Civile di Monza, and LUDOVICO MUCCHI, Docente, Dirigente la Sez. Radiol. della Clinca Chirurgica dell'Università di Milano. A volume of 152 pages with 140 illustrations. Licinio Cappelli, Bologna, 1947.

The authors have studied 117 pathological sinuses by means of plain and of laminagraphic roentgenograms and this monograph is an account of their experiences. It is richly illustrated (140 figures), well printed on good paper, and because of the wealth of illustration can be studied with profit by those who are interested in laminagraphy of the sinuses. The largest amount of space is devoted to case histories, in which the patients are described in minute and perhaps unnecessary detail. These histories are preceded by a short introduction and are followed by the conclusion. The authors confirm the value of laminagraphy and maintain that it finds great usefulness in demonstration of the amount of bony damage suffered by the walls of the sinuses either by osteoporosis following purulent sinusitis or by pressure atrophy in cysts and tumors. The diagnosis of polypoid hypertrophy of the mucosa is also facilitated by the demonstration of cyclic contours in laminagraphic films, while the plain films show only uniform cloudiness.

This monograph has the good points and the pitfalls of many similar European works. It combines excellent pictorial demonstration with excessive and perhaps unimportant details within the text.

In Memoriam

FORREST LeROY SCHUMACHER, M.D.

1885–1947

Forrest LeRoy Schumacher died at his home in Bellevue, Penna., June 2, 1947. He was born in Hazleton, Penna., Dec. 12, 1885, and was graduated from the University of Pennsylvania in 1908. After serving an internship at the Allentown Hospital, he began the practice of medicine in Dubois, Penna. In 1910 he undertook the study of radiology at the Mercy Hospital, Baltimore, Md., and in 1914 was appointed to the staff of the Dubois Hospital.

Dr. Schumacher was one of the organizers and a charter member of the Roentgen Ray Society of Central Pennsylvania, now the Pennsylvania Radiological Society, and was president of the society in 1918–1919. In 1923 he was made associate roentgenologist at St. Francis Hospital, Pittsburgh, and in the same year became associated with Dr. Zoe Allison Johnston in private practice. In 1927 he received the appointment of roentgenologist to the Suburban General Hospital, Bellevue, Penna., and to the Homestead Hospital, Homestead, Penna., and in 1928 became radiologist to the Pittsburgh Skin and Cancer Foundation. In 1935 Dr. Schumacher joined the Radiological Staff of the Falk Clinic of the University of Pittsburgh, and was made instructor in the Department of Radiology. In the same year he was certified as a diplomate by the American Board of Radiology. He was a member of the Radiological Society of North America and a fellow of the American College of Radiology. He served as President of the Pittsburgh Roentgen Society in 1937.

Dr. Schumacher was married in October 1917 to Miss Emma Veil, of Punxsutawney, Penna., who survives him. Their son, Forrest V. Schumacher, M.D., is at present serving with the Army of the United States, holding the rank of Captain.

H. NORTON MAWHINNEY, M.D.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to cooperate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates. Address: Howard P. Doub, M.D., The Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Harold Dabney Kerr, M.D., Iowa City, Iowa.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary*, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Courtney S. Stickley, M.D., Bell Bldg. Montgomery. Next meeting at the time and place of the Alabama State Medical Association meeting.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and annually at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION. *Secretary*, Moris Horwitz, M.D., 2009 Wilshire Blvd., Los Angeles 5. Meets second Wednesday of each month at County Society Bldg.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Ivan J. Miller, M.D., 2000 Van Ness Ave. Meets monthly on the third Thursday at 7:45 P.M., January to June at Lane Hall, Stanford University Hospital, and July to December at Toland Hall, University of California Hospital.

Colorado

DENVER RADIOLOGICAL CLUB. *Secretary*, Mark S. Donovan, M.D., 306 Majestic Bldg., Denver 2. Meets third Friday of each month, at the Colorado School of Medicine and Hospitals.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Robert M. Lowman, M.D., Grace-New Haven Hospital, Grace Unit, New Haven. Meetings bimonthly, second Thursday.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Beals, M.D., St. Luke's Hospital, Jacksonville. Meets semiannually, in April, preceding the annual meeting of the Florida Medical Society, and in November.

Georgia

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert Drane, M.D., De Renne Apartments, Savannah. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, T. J. Wachowski, M.D., 310 Ellis Ave., Wheaton. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April, at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, J. A. Campbell, M.D., Indiana University Hospitals, Indianapolis 7. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville.

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2. Meets second Friday of each month at Louisville General Hospital.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 P.M.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, Harry A. Miller, 2452 Eutaw Place, Baltimore.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg., Minneapolis 2. Regular meetings in the Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, O. A. Neely, M.D., 924 Sharp Building, Lincoln. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary-Treasurer*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Raphael Pomeranz, M.D., 31 Lincoln Park, Newark 2. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway, L. I.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Abraham H. Levy, M.D., 1354 Carroll St., Bklyn. 13. Meets fourth Tuesday of every month, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month, October to May, inclusive.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary-Treasurer*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings in January, May, and October.

LONG ISLAND RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Wm. Snow, M.D., 941 Park Ave., New York 28.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary*, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meets at Strong Memorial Hospital, third Monday, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary-Treasurer*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 1338 Second St., N., Fargo.

Ohio

OHIO RADIOLOGICAL SOCIETY. *Secretary*, Carroll Dundon, M.D., 1030 Reibold Bldg., Dayton 2. Next meeting at annual meeting of the Ohio State Medical Association, May 1948.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Edward T. Kirkendall, M.D., 700 North Park St., Columbus 8.

CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Eugene L. Saenger, M.D., 735 Doctors Bldg., Cincinnati 2. Meets last Monday of the month, September to May.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George L. Sackett, M.D., 10515 Carnegie Ave., Cleveland 6. Meetings at 6:30 P.M. on fourth Monday, October to April, inclusive.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Peter M. Russo, M.D., 230 Osler Building, Oklahoma City. Meetings three times a year.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wm. Y. Burton, M.D., 242 Medical Arts Bldg., Portland 5. Meets monthly, on the second Wednesday, at 8:00 P.M., in the library of the University of Oregon Medical School.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Calvin L. Stewart, M.D., Jefferson Hospital, Philadelphia 7. Meets first Thursday of each month at 8:00 P.M., from October to May in Thomson Hall, College of Physicians, 21 S. 22d St.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, R. P. Meader, M.D., 4002 Jenkins Arcade, Pittsburgh 22. Meets second Wednesday of each month at 6:30 P.M., October to June.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

Tennessee

MEMPHIS ROENTGEN CLUB. Meetings second Tuesday of each month at University Center.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frére, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meetings on third Monday of each month in Dallas in the odd months and in Fort Worth in the even months.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth 4. Next meeting Jan. 17, 1948.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. Lowry Allen, M.D., Judge Bldg., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

UNIVERSITY OF UTAH RADIOLOGICAL CONFERENCE. *Secretary*, Henry H. Lerner, M.D. Meets first and third Thursdays, September to June, inclusive, at Salt Lake County General Hospital.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, E. Latan Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Homer V. Hartzell, M.D., 310 Stimson Bldg., Seattle 1. Meetings fourth Monday October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, S. R. Beatty, M.D., 185 Hazel St., Oshkosh. Two-day meeting in May and one day at annual meeting of State Medical Society in September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 to 5 P.M., September to May, inclusive, Room 301, Service Memorial Institute, 426 N. Charter St., Madison 6.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, E. M. Crawford, M.D., 2100 Marlowe Ave., Montreal 28, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origéne Dufresne, M.D., Institut du Radium, Montreal. Meets on third Saturday of each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

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ROENTGEN DIAGNOSIS

Radiology and the General Practitioner. Bede J. Harrison. Canad. M. A. J. **55:** 576–580, December 1946.

The percentage of radiological amateurs in the medical profession is quite high. Many seem to think that any x-ray film has its full story plainly written in the photographic emulsion for anyone to read who wishes. With practically no understanding of the principles of technic, and in complete ignorance of the laws of perspective, projection, and penetration, the amateur radiologist will proceed to infer the presence or absence of a pathological condition on the basis of films for the production and explanation of which he lacks the necessary basic knowledge.

It is the author's feeling that medical students are not being taught radiology properly. We must dismiss the idea that a student should be taught to recognize a disease from the film. We must remember that he is being trained as a general practitioner and that what will help him most is the knowledge of what lesions and what diseases can produce radiological changes. Instead of working from the film back to the disease, the student must be taught to look in the other direction and to proceed from the differential diagnosis to the x-ray investigation. BERT H. MALONE, M.D.

Roentgenologic Diagnosis: Changes Resulting from Chemotherapy. Arthur C. Christie and George M. Wyatt. J. A. M. A. **132:** 895–898, Dec. 14, 1946.

The use of penicillin, the sulfonamide compounds, and allied products has so greatly altered the course of many infectious diseases that revision of roentgenologic criteria for diagnosis is necessary. Several cases are cited illustrating the changes in pathologic anatomy resulting from the use of these drugs.

A boy of four had swelling, redness, and extreme tenderness of the wrist four days after eruption of pustular chicken pox. A total of 1,510,000 units of penicillin was given parenterally in eleven days. The symptoms promptly subsided. Roentgenograms two days after onset showed no bony abnormality. Two days later a small area of bone destruction at the distal end of the radius was visualized and a definite diagnosis of osteomyelitis was made. Films eleven months later showed only a slight scar at the site of the original disease and no disturbance in bone growth. The complete series of films with the history and record of treatment made an understandable picture, while a single film might have been very confusing. Adequate dosage of penicillin killed the organisms of osteomyelitis *in situ* and entirely altered the course of the disease.

Four cases are presented to illustrate the partial attenuation of infection by inadequate therapy, converting an acute infection into a chronic one of low-grade virulence with resultant roentgenographic changes. It will suffice to summarize one of these here. A woman, twenty-four, had severe pain in the right thigh two weeks after a "tonsil infection(?)" She had clinical and laboratory evidence of infection, though the roentgenogram showed no abnormality. She was given 18 gm. of sulfadiazine in forty-eight hours. Three months later roentgen study showed extensive moth-eaten destruction of the entire femoral shaft with elevated periosteum and subperiosteal new bone. She was given 1,600,000 units of penicillin parenterally in eight days. Two months later a roentgenogram showed complete healing of osteomyelitis with decided thickening of the femoral cortex.

Still another case illustrates the effect of inadequate penicillin therapy on a soft-tissue abscess the presence of which was unsuspected. A man, twenty-three, had a hard, fixed mass in the right upper quadrant of the abdomen, with intermittent pain in the right side for two years. Prior to this he had had carbuncles which cleared spontaneously and a gonorrheal infection treated with 200,000 units of penicillin. A roentgenogram made during this time showed enlargement of the upper pole of the right kidney and pressure deformity of the upper calyx. Later pyelographic studies suggested renal tumor, but a final diagnosis of perinephritic abscess was made. Surgical exploration confirmed this diagnosis.

The authors emphasize the necessity of careful analysis of the history and therapeutic management of infectious diseases if accurate diagnosis and prognosis are to be made from roentgenologic studies, particularly when inadequate therapy has been used.

BERNARD S. KALAYJIAN, M.D.

THE HEAD AND NECK

Intracranial Air Studies in Infants and Children. Martin Schneider. Texas State J. Med. **42:** 485–489, December 1946.

Six pediatric cases are presented in which the clinical history and neurological examination suggested diagnoses which were confirmed or modified by intracranial pneumography. The author warns of the dangers involved and cites the precautions necessary when the procedure is considered. In his experience the examination has resulted in a reduction of the number of simple decompressions performed. As a result, more specific operations and radiotherapy can be carried out. Roentgenograms of representative cases are reproduced, including porencephaly, glioblastoma, cyst of the septum pellucidum, cerebellar tumor, medulloblastoma, and a vascular glioma. Brief case reports are also included. In children intracranial air studies are of particular value because so often the histories and even the examinations are unsatisfactory for accurate localization of the lesion. STANLEY H. MACHT, M.D.

Malignant Tumors of the Nasopharynx: A Diagnostic Blind Spot. Radiation Therapy Conference. Simeon T. Cantril and Franz Buschke, Editors. West. J. Surg. **54:** 494–496, December 1946.

There have been accepted for treatment in the Tumor Institute of the Swedish Hospital, Seattle, Wash., since 1939, 18 patients with malignant tumors of the nasopharynx. In 14 of the series the disease was already advanced owing to failure of the physicians previously consulted to recognize the nature of the lesion. In one case, even though cervical lymph node involvement was present no attempt was made to discover a primary tumor and a year elapsed before the patient was referred to the Tumor Institute.

An illustration of the base of the skull from the book by Cutler and Buschke (Cancer Diagnosis and Management. Philadelphia, W. B. Saunders Co., 1938) is reproduced, showing the intimate relation between the

cranial nerves and the nasopharynx, explaining the cranial nerve signs encountered.

Roentgen therapy in this series of cases showed a single cure of more than five years duration, in a lymphoepithelioma. Several patients had been treated recently and the remainder had recurrences or had died of cancer.

Illustrative cases are presented.

SYDNEY F. THOMAS, M.D.

Odontogenic Tumors: A Survey of 75 Cases. Kurt H. Thoma and Henry M. Goldman. Am. J. Orthodontics **32:** 763–790, December 1946.

A new classification of odontogenic tumors is presented together with a description of each type. The authors also discuss the inductive effects of one tissue upon another as in the mixed types—those containing fibrous connective tissue and dentine with epithelial strands. They suggest an analogy to the situation in the early embryo, where differentiation of a tissue such as muscle leads to the differentiation of a fascia surrounding it. A number of good roentgenograms and photomicrographs are reproduced. The classification is as follows:

I. Epithelial tumors
   1. Adamantoblastoma
   2. Enameloma
II. Mesenchymal tumors
   1. Odontogenic fibroma
   2. Dentinoma
   3. Cementoma
III. Odontogenic mixed tumors (or odontomas)
   1. Soft odontoma
   2. Soft and calcified odontoma (adamantoblastoma arising in conjunction with an odontoma but not as well differentiated as the completely formed odontoma)
   3. Completely formed odontoma with enamel, dentine, pulp, cementum, periodontal membrane.
      (a) Compound (many small teeth)
      (b) Complex (irregular tooth structure)

This is an excellent paper, but of such length and so rich in detail that an entirely adequate abstract cannot be made.

ZAC. F. ENDRESS, M.D.

THE CHEST

Tuberculosis in Industry. Frederick Heaf. Brit. M. J. **2:** 975–979, Dec. 28, 1946.

Heaf points out that not only is the age when the primary tuberculous infection is received rising, but that the age group showing the highest incidence of tuberculosis is also higher. The rate of discovery of cases has increased, so that the rise in incidence does not represent a true increase in development of the disease. Some consider that the increase in case-finding, mainly by radiography, accounts for 50 per cent of the rise. Poor hygienic conditions are probably the chief factors in the remaining 50 per cent, since, where resistance is maintained at a high level, as in sanatoria or village settlements, constant contact with highly infectious cases fails to produce tuberculosis in the large majority of the staff.

While harmless dusts may indirectly spread tuberculosis by causing chronic catarrh in individuals with undiscovered active lesions, other dusts bear a specific relationship to the development of the disease. Among the grinders of Sheffield the death rate from respiratory tuberculosis in 1938 was reported to be four times the rate for all persons over fifteen in Sheffield. Of 1,397 deaths due to silicosis in 1932–39, active tuberculosis was present in 797 cases. Numerous reports have shown that dormant tuberculous lesions may become active when a simple silicosis has developed. Light work under bad conditions can be more harmful than heavy work under good conditions, and heavy work and poor economic conditions are a serious combination.

In conclusion, Heaf states that occupations rarely cause tuberculosis, but conditions of labor can predispose to it. A fundamental principle is the exclusion of infectious persons (in part by mass radiography) from normal industry. However, pre-employment radiography imposes a liability on the employer when engaging proved healthy persons in a hazardous industry.

ELLWOOD W. GODFREY, M.D.

Tuberculosis in the Alabama State Hospitals. Mass Radiography for Its Control. A. H. Russakoff. Am. Rev. Tuberc. **55:** 93–101, January 1947.

The author reports the results of a mass survey of the chests of patients confined to several of the Alabama State Hospitals for mental patients. Thirty-five millimeter film was used and all suspects were checked with 14 × 17-inch films. The material is presented in tabular form. A total of 3,272 white and 1,865 colored patients were examined. The prevalence of tuberculosis was found to be 5.4 per cent for the white and 2.3 per cent for the colored patients. The incidence was highest for the white males (6.6 per cent) and lowest among the colored males (2.1 per cent).

L. W. PAUL, M.D.

The Azygos Lobe in Photofluorography. Walter O. Pendley. U. S. Naval M. Bull. **46:** 1920–1927, December 1946.

The azygos lobe was discovered by the anatomists as early as 1778, but the first description of its appearance on the roentgenogram was that of Wessler and Jaches in 1923 (Clinical Roentgenology of Diseases of the Chest. Troy, N. Y., Southworth Co., 1923). It is now generally agreed that the azygos lobe is not congenital in origin but is a developmental phenomenon. Three types have been described: type A, more or less horizontal, cutting the outer or lateral border of the lung at some point between the apex and a position 2 inches below; type B, more nearly vertical, dividing the apex into lateral halves; type C, vertical, cutting off a small tongue-shaped lobe from the inner or mediastinal surface, the pedicle being attached to the upper margin of the lung root.

In a study of 25,000 fluororoentgenograms, the author found 404 instances of azygos lobe, an incidence of 1 6 per cent. Type A constituted 3.71 per cent of the group (15 cases), Type B 81.19 per cent (328 cases), and Type C 15.1 per cent (61 cases).

The chief significance of the azygos lobe in photofluorographic studies is the confusion which it may cause and its possible misinterpretation as disease of the lung. It may itself be the seat of disease: there are reports in the literature of complete atelectasis of the

azygos lobe, tuberculosis affecting this lobe alone, and pleural effusions into the meso-azygos.

SYDNEY F. THOMAS, M.D.

Pneumoconiosis in Dockers Dealing with Grain and Seeds. Lasar Dunner, R. Hermon, and D. J. T. Bagnall. Brit. J. Radiol. **19:** 506–511, December 1946.

The chests of 55 dock workers unloading grain and seeds were studied. The atmosphere was filled with dust arising from the grain (oats, barley, wheat, and maize) and seeds (millet, cotton, dari, rape, and palm-kernel). Twenty-six of the workers were found to have active tuberculosis and 4 quiescent tuberculosis; 11 showed reticulation and fibrosis resembling pneumoconiosis, and 14 were normal.

The patients with pneumoconiosis, to consideration of whom this paper is limited, complained of cough with expectoration, which was sometimes blood-streaked, and dyspnea. There was considerable variation between the physical signs and the x-ray observations.

An analysis of the dusts revealed appreciable amounts of silica, also fine hairs, starch grains, and cellular organic matter. No tubercle bacilli were recovered from the dust.

Although no postmortem confirmation is reported, the authors feel that exposure to dust from grains and seeds can produce fibrosis of the lungs.

SYDNEY J. HAWLEY, M.D.

Association of Pneumonia with Erythema Multiforme Exudativum. Commission on Acute Respiratory Diseases. Arch. Int. Med. **78:** 687–710, December 1946.

Six cases of erythema multiforme exudativum with predominant involvement of the mucous membranes of the mouth, seen during a three-year period at the Regional Station Hospital, Fort Bragg, N. C., are described. In 3 of the 6 cases, clinical and roentgen evidence of pulmonary involvement was demonstrated. On the basis of clinical and laboratory findings, it was believed that the pulmonary lesions were due to non-bacterial pneumonia. The pneumonia appeared to be an integral feature of the disease and could not readily be considered a secondary complication.

In many respects the pneumonia in the present series of cases bore a close resemblance to primary atypical pneumonia. The prodromal symptoms, absence of physical signs of consolidation, the radiographic character of the lesion, the minimal degree of respiratory distress, the absence of pleural pain or bloody sputum, and the relatively normal leukocyte count were features not unlike those commonly encountered in primary atypical pneumonia. The authors believe that it is probable that pneumonia occurs more often in erythema multiforme exudativum than has been recognized. It is now well accepted that instances of mild primary atypical pneumonia can be recognized only by roentgenograms in a considerable percentage of cases. It appears probable that a similar difficulty attends the diagnosis of the pneumonia associated with erythema multiforme exudativum.

Transitory Pulmonary Infiltrations and Apical Cavitation Associated with Eosinophilia. A. Elkeles and N. R. Butler. Brit. J. Radiol. **19:** 512–517, December 1946.

Loeffler's syndrome, characterized by transitory pulmonary infiltrations in any part of the lung, with eosinophilia, is frequently discovered in mass surveys. One such case is reported in detail, with serial roentgenograms covering a period of six months. This case showed a shadow which indicated cavitation in the apex of one lung, indistinguishable, except for its rapid disappearance and the absence of tubercle bacilli, from a tuberculous cavity.

The diagnosis is established by the absence of tubercle bacilli, the rapid disappearance of the infiltrations, the migration of the infiltrations to other parts of the lungs, the eosinophilia, and the disproportion between the clinical symptoms and the extent of pulmonary involvement.

The condition is quite definitely established as allergic in origin. A great variety of allergens may be responsible. Numerous other manifestations of allergy are present in these patients.

SYDNEY J. HAWLEY, M.D.

Simple Spontaneous Pneumothorax in Apparently Healthy Individuals. A Report of Twenty-four Cases. R. F. Niehaus. Am. J. Roentgenol. **57:** 12–27, January 1947.

Simple (benign, idiopathic, or temporary) spontaneous pneumothorax may be defined as pneumothorax occurring suddenly in otherwise healthy subjects. There is little or no fever and pleural effusion is infrequent or small in amount. Re-expansion of the lung takes place in two to six weeks. Usually there are no residual ill effects. Neither lung shows evidence of active pulmonary tuberculosis. Of the 24 cases reported in this paper, 20 were in males and 21 occurred between the ages of twenty and forty years.

Kjaergaard (Acta med. Scandinav., supp. 43, 1932) maintains that simple spontaneous pneumothorax is due to rupture of a valve vesicle anywhere on the surface of the lung. These vesicles may be due to scar tissue or may be emphysematous or congenital. All three types are believed to have a valve-like structure at their pleural attachment. According to Kjaergaard, air can pass from a terminal bronchiole into the vesicle but is prevented from passing out again. The vesicle gradually increases in size and pressure is built up with thinning of the wall of the vesicle; rupture takes place when pressure is suddenly increased, as in coughing or sneezing. Kjaergaard thinks it impossible for a normal pleura to rupture through coughing or by muscular exertion. Rupture does not occur in bullous emphysema because no valve-like mechanism exists and positive pressures are not built up in the blebs.

The clinical picture in simple spontaneous pneumothorax is usually one of sudden onset of pain on the side of the pneumothorax and shortness of breath. A history of physical exertion preceded the onset in the author's series in about 35 per cent. The acute symptoms usually subsided in a few days. The average period of time for complete re-expansion of the collapsed lung was five weeks. Nine of the 24 patients experienced a recurrent pneumothorax: 2 had alternating spontaneous pneumothorax and 7 had collapse of the same lung.

Two patients in this study have been treated for recurrent spontaneous pneumothorax by the induction of a chemical pleuritis and one patient by thoracotomy. All three have remained asymptomatic for periods varying from two to six years. Follow-up studies show 20 of the 24 patients to be in good health. Three have not been adequately followed. One has had a coronary occlusion but is alive.

The prognosis in the uncomplicated case is excellent, and recovery complete. Active pulmonary tuberculosis develops in these patients no more frequently than in any other similar age group.

CLARENCE E. WEAVER, M.D.

Resectable Pulmonary Lesions. Wm. Ray Rumel. Rocky Mountain M. J. **43:** 989–1002, December 1946.

The author begins with a brief statement as to the improved surgical treatment of pulmonary lesions and points to an operative mortality (figures from several clinics being included) of only 1 to 3.5 per cent, including lobectomies and pneumonectomies. Most of us who have been in contact with the work of clinics where the advances in pulmonary surgery have been made available will share his enthusiasm and rejoice in the successful attack on one more group of entities which in our student days were passed glumly by as hopeless.

The subject is taken up systematically, beginning with diagnosis, including history and physical examination, laboratory studies, roentgenography and fluoroscopy, bronchography, bronchoscopy, artificial pneumothorax, thoracoscopy, and finally exploratory thoracotomy. The author states at the outset that a differential diagnosis by means of x-rays is usually not possible; along with this he condemns the policy of "watchful waiting," for obvious reasons.

The more significant lesions are taken up in order:

Bronchiectasis: In plain films, ordinary chronic bronchitis produces just about the same sort of pulmonary markings as does bronchiectasis. Other signs, such as mottling or emphysema may be present, but less frequently. The bronchogram is diagnostic.

Primary Tumors: About 93 per cent of primary pulmonary tumors are malignant. If bronchial adenomas, which often show malignant change, are included, the proportion rises to about 99 per cent. When cough continues over an inordinate interval, without obvious etiology, or when the cough is productive of even a small amount of blood-tinged sputum, bronchoscopy is in order. It should be done also in any patient with a unilateral wheeze. Most of the shadows cast by the peripherally located lesions, those outside the stem bronchus, are due to atelectasis. Recurrent attacks of "flu" may signify a pulmonary neoplasm. On the other hand the ordinary appearances of continued health may be maintained.

One case with an obvious moral is cited: the clinical course before operation was long enough that the patient received a good bit of x-ray therapy; four weeks after operation the bronchus opened, producing an empyema which was drained, but the outcome was fatal. [In pulmonary surgery, as in thyroid surgery, one of the obstacles to success would seem to be the ill advised use of radiation while operation is delayed. No one has yet found a satisfactory answer to the question as to how one may expect to control the spread before operation if it cannot be controlled afterwards.—P. J. D.]

Pulmonary sarcoma is something of a rarity, though the author's series contains 2 cases, with survivals of two and three years, respectively.

Bronchial adenomas have been a matter of some dispute: some have considered them thoroughly benign, and dealt with them by bronchoscopy; others consider them potentially malignant and regard thoracotomy as the preferred approach.

Lung Abscess: The author feels that the stage of indecision is well past in their clinic so far as lung abscess is concerned: he states that the firmly organized and thick-walled variety may as well be despaired of medically, and should be dealt with promptly by surgery, since it constitutes a very considerable menace to life if allowed to remain active.

Cysts: Congenital cysts are true cysts, fluid-containing, and should be removed, since they represent a hazard. They are among the lesions most amenable to surgery.

This article is earnestly recommended to all interested in the subject of chest surgery. The author presents his material logically, with assurance, and in such a manner that one recognizes the statement of a mature surgeon who is happily free of bias or coloring or any ulterior motive.

PERCY J. DELANO, M.D.

Cardiac Aneurysm, with an Account of a Case Followed over an Unusually Long Period. G. H. Robertson. New Zealand M. J. **45:** 527–534, December 1946.

In the case recorded here cardiac enlargement was first noted in 1918 while the patient was on duty in the Army, at which time he was twenty-two years old. He suffered from precordial pain and dyspnea on exertion during the next four years, but was then able to carry on hard work for twelve years. In 1935 he had some dyspnea on exertion but continued in his work. In 1937 evidence of aneurysm of the left ventricle was first demonstrated radiographically. There was a localized bulge projecting forward and to the left just above the apex. There was calcification at its periphery and fluoroscopy showed diminished pulsation as compared with the adjacent ventricular border. Electrocardiographic studies were confirmatory.

In the years which followed the patient worked almost continuously at heavy labor, such as farm work and road building, taking short periods off because of dyspnea. In 1946 he was still able to work for a few days at a time but became tired easily and had suffocating tightness of the chest if he walked rapidly.

The author reports that at the last examination in April 1946 the aneurysm had not increased in size, but the calcification had gradually progressed and was then quite extensive. The patient was still alive in September 1946.

The author believes this man had cardiac infarction in 1918 while acting as a "runner" in the service, and that the aneurysm developed at the site of the infarct. This would make the present duration of the aneurysm at least twenty-six years. The longest previous survival reported has been ten years.

BERNARD S. KALAYJIAN, M.D.

Right-Sided Aorta with Atypical Coarctation Involving Only the Left Subclavian Artery. Hypertension. Arthur M. Master. Am. Heart J. **32:** 778–785, December 1946.

The author gives the history of a young, well developed, asymptomatic healthy midshipman, aged twenty-two, in whom was found a right-sided aorta, with a coarctation of the left subclavian artery. Promotion was denied him because of a hypertension. Physical examination revealed a short systolic murmur over the base; a slow pulse ranging from 45 to 60 per minute; pulsations in the left carotid, axillary, brachial, and radial arteries weaker than those on the right side. The blood pressure readings on the right arm were

158–170/60–76; those on the left were 104–124/70–80. The EKG revealed a sinus bradycardia, 42 beats per minute. Coarctation was suspected because of the hypertension in the right upper extremity, but the diagnosis was dismissed for lack of other corroborating evidence. X-ray studies revealed a right-sided aorta. The esophagus, at the level of the aortic arch, was found to be displaced anteriorly and to the left of the aorta. There were no cervical ribs. A congenital anomaly of the left subclavian was suspected to account for the small pulse. An angiocardiographic examination disclosed an enlargement of the left ventricle, displacement of the interventricular septum to the right, and an atresia of the left subclavian artery. There was no narrowing of the aorta.

The author believes that a localized coarctation of the left subclavian artery should be considered in a patient with a small or absent left radial pulse, a hypertension in the right arm, and normal expected blood pressure in the femoral vessels, after the exclusion of a large cervical rib, an anatomic variation of the radial artery, an aortic aneurysm, and tumor compressing the left subclavian artery. HENRY K. TAYLOR, M.D.

Peritoneopericardial Diaphragmatic Hernia. Report of a Case in a Newborn Infant Successfully Corrected by Surgical Operation with Recovery of the Patient. Angus K. Wilson, William R. Rumel, and O. L. Ross. Am. J. Roentgenol. **57:** 42–49, January 1947.

Only 8 cases of peritoneopericardial diaphragmatic hernia were discovered by the authors in a careful search of the literature. In 2 of these operation was done, but the patients failed to survive. Five cases, discovered at autopsy, were without symptoms; hence it would appear that the defect is not inimical to life. An accurate diagnosis has not been made prior to operation or autopsy examination.

The authors report a case with herniation of the abdominal contents into the pericardium. The patient survived operation, which was performed at the age of seven weeks, and was still without symptoms seven months later, when this report was made. Clinically the condition cannot be distinguished from the more common peritoneopleural diaphragmatic herniae. Peritoneopericardial herniation should be suspected in all cases showing cardiorespiratory embarrassment, especially those having postprandial cyanosis relieved by vomiting. The diagnosis can be made roentgenologically if coils of intestine can be identified by gas or opaque medium content obscuring the cardiac shadow and within the confines of the distended pericardium.

CLARENCE E. WEAVER, M.D.

THE DIGESTIVE SYSTEM

A Contribution to the Roentgen Diagnostics of Limited Esophagitis. Sölve Welin. Acta radiol. **27:** 461–471, May 6, 1946.

While inflammatory changes in the esophagus, particularly in the lower third, are quite common in postmortem material, the diagnosis is not commonly made antemortem. The author reviews the literature and presents 9 cases in which the diagnosis was made clinically and confirmed microscopically. The predominant symptom in all cases was progressive dysphagia. In 5 of the cases an original diagnosis of cancer had been made.

The typical course of esophagitis may be divided into three stages. In early cases the mucous membrane is edematous and bleeds easily; roentgenologically the thick folds and stiffness of the wall are suggestive but the differentiation from carcinoma is difficult. In the second stage, the mucous membrane of the upper portion is relatively normal, while that in the lower portion is inflamed and covered by fibrin. The roentgenologic picture is that of an elongated smooth funnel-shaped constriction of the lower portion. In the final stage, the mucous membrane is thin, pale, and scarred, and on fluoroscopic or roentgen examination the constriction is smooth, with a sharply demarcated upper margin, but usually indistinct lower end, and there is more or less dilatation above. Several illustrations are included.

ELIZABETH A. CLARK, M.D.

Simple Non-Sphincteric Localized Esophageal Spasm: Case Report. Morris Weiss and Leonard Long. Am. J. Digest. Dis. **13:** 375–377, December 1946.

The more common spasms of the esophagus are of two types, (1) sphincteric (cricopharyngeal spasm and cardiospasm) and (2) non-sphincteric, secondary to organic disease. Simple non-sphincteric spasm, because of its mild symptoms, is not often diagnosed. It may occur in any age group and both sexes are equally affected. The cause of this condition is not clear, but nervous instability is usually a predominating factor. The outstanding symptoms are dysphagia and substernal pain, which may vary from a dull ache to severe paroxysms resembling angina pectoris.

A case report is given of a colored soldier who was admitted to the hospital complaining of inability to swallow and substernal pain. He gave an indefinite history of having swallowed lye at the age of five, and of having intermittent attacks of dysphagia at irregular intervals thereafter. The last attack occurred about a year before at another army camp. Barium paste was swallowed with some difficulty, stopping abruptly at the level of the second thoracic vertebra. No barium passed beyond this point during a fifteen-minute period of observation. The patient was given a liquid diet and 1/150 gr. of atropine every eight hours. Within twenty-four hours he was able to swallow normally and a second roentgenoscopic study showed no evidence of obstruction. Esophagoscopic examination revealed an area of narrowing beyond which the tube could not be passed without force, but when this was repeated after intense sedation, the esophagoscope was passed along the entire length of the esophagus. No lesion could be seen. The patient left the hospital in a few days. About two months later he returned with the same symptoms, which again disappeared after a week of treatment. JOSEPH T. DANZER, M.D.

A Foreign Body Impacted at the Upper Opening of the Œsophagus for Over Five Weeks. Clifford L. Rosefield. M. J. Australia **2:** 843–844, Dec. 14, 1946.

A soldier complained of a sore throat and dysphagia. Roentgenograms revealed two apparently separate wire-like bodies at the level of the hyoid bone and cricoid cartilage, respectively. Actually these were attached to an acrylic denture containing five teeth, but since this was radiotranslucent it was not demonstrable and was discovered by laryngoscopy only after it was learned that a denture had been missing since an epileptiform attack several weeks earlier. An interesting feature of

the case is the fact that the clasp of the denture remained impacted in the upper part of the wall of the esophagus for more than five weeks, producing considerable local reaction, which, however, subsided rapidly after removal of the foreign body. It is pointed out that some dentures are made without clasps, and that roentgenography would be of no value in locating these, should they become impacted in the air or food passages.

Gastragogue Effect of Laxatives and Allyl-Bromide-Mixture. Henry M. Feinblatt and Edgar A. Ferguson, Jr. Am. J. Digest. Dis. **13:** 386–390, December 1946.

The word "gastragogue" has been coined to identify a substance that will hasten the emptying of the stomach. To study the effect of cathartics on gastric emptying, 7 patients were given a barium meal and in six hours films were taken in the vertical and horizontal axes. A repeat examination was done in each case with the same mixture of barium, followed by a laxative containing aloin, cascara, extract of rhubarb, and phenolphthalein. A comparison study of the cases showed that there was very little difference in the amount of retention in the stomach after six hours. A study of various other cathartics showed no effect on stomach emptying time. The effect of allyl bromide was then studied, the same series of patients being given two 5-grain tablets of the allyl-bromide mixture with the barium meal, two tablets two hours later, and two tablets four hours later. It was found that the patients who had fairly marked retention in the other tests had little or no retention after six hours when the allyl bromide was given. JOSEPH T. DANZER, M.D.

Early Indications of Adhesive Small Bowel Obstruction. Claude J. Hunt. Am. J. Surg. **72:** 865–868, December 1946.

The early diagnosis of small bowel obstruction is dependent upon the correlation of three characteristic clinical findings with proper interpretation of radiographic findings. The clinical findings are synchronous: typical, diffuse, colicky abdominal pain, visible peristaltic waves, and metallic borborygmi. The second finding, visible peristalsis, may be absent if the degree of distention is great. In addition the presence of a protruding mass on the surface of the abdomen is considered evidence of strangulation. Vomiting and the passage of gas and feces are not reliable signs, as they may or may not occur. The degree of abdominal tenderness and rigidity is said to be less than that seen in specific colics or acute localized inflammation.

The x-ray examination is the only positive means of establishing early diagnosis, with differentiation between strangulated and non-strangulated obstruction. The characteristic roentgen findings of gas in the small bowel, the typical "stairstep" pattern, and visualization of the valvulae conniventes are described as diagnostic of non-strangulated obstruction of the small bowel. A strangulated obstruction is described as having no definite pattern, but the valvulae conniventes are not visualized due to the extravasation of blood into the lumen of the bowel, and the distended loops arrange themselves in whatever portion of the abdomen the obstruction occurs. Proximal distention is slow to appear in this type of obstruction.

Decision as to the type of treatment requires an accurate diagnosis. Non-strangulated obstruction does not demand immediate operation, and the patient may be prepared by chemical and fluid rehabilitation and bowel decompression. Strangulated obstruction, however, requires immediate surgery.

The author emphasizes the importance of competent assistance by the radiologist in establishing the diagnosis and thereby determining the choice of treatment.

PAUL R. NOBLE, M.D.

Present Status of the Problems of Regional Ileitis. John H. Garlock. Am. J. Surg. **72:** 875–878, December 1946.

An experience of approximately 200 instances of regional ileitis has led the author to recognize five symptomatic groups. (1) In *acute ileitis* the history and findings so closely resemble appendicitis that only rarely can a preoperative diagnosis be made. (2) *Chronic enteritis* usually presents the triad of foul, nonbloody diarrhea and cramps, loss of weight, and anemia. Abscesses and fistulae are common complications. (3) A third group is that showing *obstructive symptoms* due to diminution of the caliber of the small bowel. (4) In some cases symptoms may be due to involvement of adjacent viscera—the bladder, rectum, cecum, or pelvic organs. (5) In the fifth group the significant feature is the presence of external fecal fistulae. The author states that in his experience the most common cause for fecal fistula following appendectomy is an underlying ileitis. The pathogenesis is not believed to be a "blowing out" of the stump, but perforation of an ileal ulcer into the mesentery and fixation to the abdominal wall followed by operative or spontaneous rupture, usually in the right lower quadrant.

X-ray examination should include a barium enema study, which will serve to rule out a concomitant ulcerative colitis and may demonstrate the narrowed ileum if the ileocecal valve is incompetent. Regardless of findings in such a study, a gastro-intestinal series should be done to demonstrate the presence or absence of disease in the upper ileum or jejunum.

The treatment of ileitis is surgical except in those patients with a short history of diarrhea, suggestive x-ray findings, and no weight loss or disabling symptoms. The majority of these latter patients remain relatively well and show no change roentgenographically on follow-up examination. In the event that ileitis is found during an operation for acute appendicitis, nothing further should be done.

The operation recommended is ileocolostomy with exclusion, statistics showing better results with this procedure than with more extensive surgery. A number of practical points in the management of ileitis are given.

PAUL R. NOBLE, M.D.

Motor Dysfunction of the Biliary Tract: An Analytical and Critical Consideration. A. C. Ivy. Am. J. Roentgenol. **57:** 1–11, January 1947.

The gallbladder is evacuated by way of the cystic duct under the force of contraction which is caused primarily by the action of the hormone cholecystokinin. This hormone is produced by the upper intestinal mucosa when in contact with acid, fat, or partially digested protein. It is not produced in response to a carbohydrate meal or water. In all animals that have a gallbladder the common duct possesses a sphincteric mechanism which is intimately co-ordinated with duodenal tone and motility, but which may also act independently. It is possible for a spastic sphincter to exert

a resistance to flow greater than the capacity of the gallbladder to contract and greater than the secretory pressure of the liver. This could be a factor in the production of pain. A disturbance in the reciprocal innervation of the gallbladder and the sphincter could delay evacuation of the gallbladder or give rise to increases in intrabiliary tract pressure sufficient to cause symptoms. Morphine and pilocarpine usually cause spasm of the sphincter of Oddi. Magnesium sulfate, amyl nitrate, and nitroglycerine cause relaxation.

It seems to have been clearly demonstrated in cholecystectomized patients with a T-tube in the common bile duct that spasm of the sphincter of Oddi alone can cause pain. There are also experiments which show that pain may occur from procedures that presumably cause distention of the ducts by physiological pressures in the absence of a T-tube or other foreign body.

The difficulty in using evacuation time of the gallbladder (in cholecystography) as a criterion of the normality of the motor activity of the biliary passages is the variability observed. Whether this is due to a difference in the motor activity of the gallbladder or to a difference in the rate of evacuation of the fat from the stomach is unknown. The only solution would seem to be to give a standard stimulus parenterally. Cholecystokinin would be such a stimulus, but this is not at present available for use in man.

Visualization of the hepatic ducts is unusual. It may occur with a normal gallbladder *in situ* with or without pain, generally the latter. In the presence of unexplained pain resembling biliary colic in the cholecystectomized patient, one must assume the presence of spasm of the sphincter of Oddi and transient physiological obstruction. In some cases the induction of colic with a sixth of a grain of morphine may prove useful.

There is adequate evidence of a physiological nature, provided by a large group of investigators, to justify the view that a motor dysfunction of the biliary passages may produce symptoms or that such an entity as biliary dyskinesia exists.

CLARENCE E. WEAVER, M.D.

A Comparison of Two Cholecystographic Media. C. A. Stevenson and R. N. Smith, Jr. Texas State J. Med. **42:** 492–494, December 1946.

A comparative study was made of two media, tetraiodophenolphthalein and priodax, each being used in 500 consecutive gallbladder studies. The tetraiodophenolphthalein was given in 4 gm. doses following Kirklin's recommendations in regard to diet, time, preparation, and roentgenographic technic (Am. J. Roentgenol. **25:** 595, 1931). The priodax was given in 3 gm. doses as recommended by the manufacturers. The double dose technic was not used. The patients were questioned about nausea, vomiting, diarrhea, burning on urination, abdominal cramps, headache, backache, burning in the throat, bad taste in the mouth, insomnia, and general malaise. The term "diarrhea" was applied only if there were two or more loose stools.

The authors found that priodax produced "almost 50 per cent less of all symptoms listed, except for burning on urination and burning in the throat." Forty-two per cent of all patients receiving priodax complained of burning on urination. There was a higher incidence of symptoms after taking both media than has been reported elsewhere.

So far as the roentgenographic diagnosis is concerned, very little difference was found between the two media. Of the 500 patients receiving tetraiodophenolphthalein, 6 per cent showed the dye in the hepatic flexure. No dye was seen in the colon or small bowel in the group receiving priodax.

Since completing this series, the authors have used priodax in 4,000 cases. They state that the surgical findings have confirmed the roentgenologic diagnosis in a high percentage of all cases. They regard priodax as preferable to tetraiodophenolphthalein because it produces fewer untoward symptoms and is equally good roentgenographically. PAUL W. ROMAN, M.D.

Air in the Biliary Passages: A Review and Report of a Case. Dan C. Donald, Burton T. Meadows, and S. J. Silbermann. Arch. Surg. **53:** 652–663, December 1946.

Although the principal emphasis in the diagnosis of internal biliary fistula has been on the roentgen signs, the authors feel that proper evaluation of the clinical picture will lead to more early diagnoses. Most fistulas are due to infection or calculus. There are extensive adhesions to the bowel and thickening and fibrosis of the gallbladder wall. The clinical picture is similar to that seen in chronic biliary disease, but more severe. Colicky pains, jaundice, chills, and fever are the common signs. Diarrhea may be present, and occasional patients may be asymptomatic. Roentgen diagnosis is earlier in recent fistulas because of their larger size. The visualization of gas in the bile ducts is due not so much to the size of the fistula as to infection in the biliary tree.

Surgical treatment carries a high mortality, 50 to 60 per cent. This is due to the advanced age of the patients, the initial disease which led to fistula formation, and local changes about the fistula and in the liver. Since many of the cases are not diagnosed preoperatively, preparation of the patient may be inadequate. Moreover, the operation offers more than average technical difficulty because of the local changes in the tissues at the site of the fistula.

In the case reported the presence of the fistula was recognized roentgenographically. A barium fleck, independent of the stream of barium sulfate about the second portion of the duodenum, was interpreted as indicating the site of the fistulous opening between the duodenum and gallbladder and air was seen in the extrahepatic biliary ducts and biliary radicles. Operation was successful. LEWIS G. JACOBS, M.D.

Pancreatic Disease in the Roentgenogram. Max Lüdin. Schweiz. med. Wchnschr. **76:** 1273–1274, Dec. 14, 1946.

Roentgen diagnosis of pancreatic disease is difficult because no direct method of visualization exists and secondary signs must be employed. Thus an annular pancreas will narrow the duodenal lumen and produce a partial obstruction.

Pancreatic stones are said to be very rare. The author, however, made a roentgen study of the pancreas in 1,000 cadavers without reference to the clinical diagnosis and found evidence of calcification (over 2 mm. in diameter) in 81. Necropsy showed 55 to be cases of stone, 10 of calcification in fat necrosis, and 16 of ossification in pancreatitis or fat necrosis. Size and shape were not characteristic; most of the concretions were sandy, and single isolated stones were rare. Differen-

tiation from gallstones or renal calculi can be accomplished by contrast visualization, and from lymph node calcification by localization with reference to the duodenal loop. Calcification in vessels or in an aneurysm of the splenic artery may cause confusion, as may also a calcification of the nucleus pulposus or of a cyst wall.

Pancreatic cysts are usually recognized by the pressure defect on the stomach. Carcinoma of the pancreas is often in the tail, where it widens the duodenal loop and later compresses the duodenum or stomach. In pancreatitis the swelling may produce this same sign; abnormalities of movement such as reverse peristalsis will mark inflammation. Frostberg has described the "reversed 3" sign in chronic pancreatitis. Indurative processes, by altering the retrogastric tissues, may produce a horizontal course of the lesser curvature, often with a wavy contour; this may occur in necrotic pancreatitis, infarction, or in a thickened, edematous pancreas.

Duodenal diverticula may play a role in pancreatitis; in the literature 50 per cent of patients with duodenal diverticula showed pancreatitis as well. Another sign not infrequently seen in pancreatitis is diminished mobility of the left leaf of the diaphragm, sometimes accompanied by horizontal striations in the left base due to the lessened aeration—"plate-like atelectasis."

LEWIS G. JACOBS, M.D.

Pancreatitis as a Cause of Complete Obstruction of the Common Duct. J. Dewey Bisgard. Ann. Surg. **124:** 1009–1018, December 1946.

Bisgard reports two cases of obstructive jaundice in which an existing pancreatitis, as judged by operative findings and blood amylase studies, was the only demonstrable cause of obstruction of the common duct. In both cases the common and hepatic ducts were dilated, while the gallbladder was much smaller than normal, contracted, thick-walled, and without stones. Both patients recovered following prolonged drainage of the common duct.

Cholangiographic studies in both cases, ten and eleven days after operation, showed absence of filling of the distal intrapancreatic portion of the common duct, with wide dilatation of the duct proximal to this point. The radiopaque solution passed into the duodenum, indicating incomplete obstruction.

ELLWOOD W. GODFREY, M.D.

RETROPERITONEAL TUMORS

Primary Retroperitoneal Tumors. A Report of 95 Cases and a Review of the Literature. Bernard A. Donnelly. Surg., Gynec. & Obst. **83:** 705–717, December 1946.

Although primary retroperitoneal tumors are not of common occurrence, the author found some 500 cases in the literature to which he adds 95 seen in the University of Iowa Hospitals in the period 1925–45. On the total number of cases the present report is based. Tumors of the retroperitoneal organs are not included.

Retroperitoneal tumors frequently occur in close proximity to the urinary system, gastro-intestinal tract, or pelvic brim and present problems of diagnosis to the urologist, gastro-enterologist, general surgeon, and gynecologist. The tumors may arise from the embryologic urogenital cell ridge, adipose tissue, areolar connective tissue, fascia, lymph nodes, lymphatics, or sympathetic nervous structures. They may raise or displace any abdominal viscera and may extend into the mesentery of the sigmoid or colon and the small bowel. They have extended into the pelvic connective tissue. It is thought that they arise from embryonal mesothelial cell rests.

Grossly, primary retroperitoneal tumors may be solid or cystic, or a combination of both. They may be single or multiple. In some, bony or calcareous tissue predominates. Though these tumors may be benign, they are predominantly malignant. A wide diversity of histologic types is seen. Sarcoma is the most common malignant tumor. Of the benign tumors, lipoma was the most frequently reported in the literature, but epithelial cysts were more common in the author's series. Lipomas frequently undergo sarcomatous change.

Recurrence of retroperitoneal tumors following surgery is common, though whether this is a true recurrence or represents the development of another growth overlooked at operation is not certain. The most frequent sites of metastasis are the lungs, liver, vertebrae, and lymph nodes, in that order.

The symptoms are not pathognomonic but are due to pressure on the gastro-intestinal tract with resultant pain, nausea, loss of weight, loss of appetite, and constipation. The pressure may also involve the urinary tract with symptoms of obstruction. The most constant findings are loss of weight and an unexplained abdominal mass.

With adequate examination, the diagnosis of retroperitoneal tumor can be made in a high percentage of cases, although the exact nature of the tumor may not be disclosed. The diagnosis is usually made by exclusion. Retrograde pyelography is considered superior to intravenous pyelography and a very valuable aid in ruling out lesions of the urinary tract. (1) Anteroposterior films will show deflection of the ureter laterally or mesially; (2) lateral films will show anterior displacement of the ureters; (3) the calices will be improperly filled due to pressure from the retroperitoneal tumor; (4) the pelvis of the kidney will be displaced, flattened, compressed, and rotated by the tumor; (5) muscle shadows may be obliterated; (6) displacement of the bladder may be noted. The chief value of the gastro-intestinal x-ray picture in the diagnosis of retroperitoneal tumors is the excluding of the gastro-intestinal tract as the primary site of the lesion. Quite frequently, if the tumor is of sufficient size, the x-ray film shows that the ascending or the descending colon is displaced from its normal position.

The treatment of choice is wide excision of the tumor where it can be done without destroying vital structures. Most of the tumors have been found to be radiosensitive and x-ray therapy is indicated postoperatively, for metastasis and in inoperable cases, and should be given routinely.

VERN W. RITTER, M.D.

THE MUSCULOSKELETAL SYSTEM

Primary Sarcoma of Bone: Analysis of 71 Cases. Thomas A. Shallow and Frederick B. Wagner, Jr. Pennsylvania M. J. **50:** 233–239, December 1946.

The question of whether or not a bone tumor is malignant is a challenging problem to the clinician,

roentgenologist, and pathologist, who must collaborate to make a diagnosis.

In the past twenty-five years, 71 cases of primary sarcoma of bone were seen in Jefferson Medical College Hospital. The lesions mostly occurred in the second decade of life, and males were afflicted more often than females, in the ratio of almost 2 to 1. The series contained 35 osteogenic sarcomas, 11 chondrosarcomas, 3 fibrosarcomas, 1 liposarcoma, 1 adamantinoma, 8 Ewing's tumors, and 12 cases of multiple myeloma. In all but 3 cases there was a history of minor trauma. The outstanding symptom was pain, and the outstanding sign a swelling, with progressive enlargement.

Although roentgenologic examination is an indispensable aid in diagnosis, the findings are not standardized for the various types of lesions. For instance, the "sun-ray" appearance of osteogenic sarcoma is present in only 18 per cent of the registry cases. Only a small percentage of Ewing's tumors show onion-skin lamination, which is supposedly characteristic of the lesion. "Roentgenograms in cases of multiple myeloma frequently show punched-out defects like Swiss cheese."

Arteriography has been used by the authors as an aid to diagnosis during the last five years. They quote Inclan (J. Bone & Joint Surg. **24:** 259, 1942. Abst. in Radiology **39:** 505, 1942), who claims that arteriographic signs of malignant bone tumors consist of new pedicles from the main artery with numerous irregular branches entering the lesion. The authors have found that arteriography is of some value, but in this article they show that the findings are often inconclusive and sometimes misleading.

For routine histologic section the double tourniquet method is used, one tourniquet being applied just above the tumor, the other above the site of contemplated amputation. If the lesion is found to be malignant on frozen section, amputation is done immediately. Aspiration biopsies are most valuable in multiple myeloma.

Bence-Jones protein was present in about half of the cases of multiple myeloma. Blood calcium, phosphorus and alkaline phosphatase determinations must be performed to rule out hyperparathyroidism.

Amputation was performed in 30 cases of this group and local operation in 10 cases. Of the 71 patients, 53 died within three years, 3 are alive but with evidence of the disease, and 15 are alive and apparently well.

JOSEPH T. DANZER, M.D.

Multiple Myeloma: A Review of Eighty-Three Proved Cases. Edwin D. Bayrd and Frank J. Heck. J. A. M. A. **133:** 147–157, Jan. 18, 1947.

Pain was found to be the most frequent clinical manifestation of multiple myeloma. Nearly three-fourths of the authors' 83 patients had multiple bone lesions and a similar number had elevated serum proteins. Bence-Jones proteinuria was present in slightly over half of the cases. Twelve per cent showed no bone abnormality, while 9 per cent showed osteoporosis alone. A sixth of the group had pathological fractures of bones other than vertebrae; twelve per cent had tumor formation. Other significant findings were evidence of renal dysfunction, excessive rouleaux formation, anemia, hypercalcemia, myeloid immaturity, myeloma cells in the peripheral blood, and epistaxis. The above findings are all carefully discussed and correlated.

Diagnosis should be confirmed by sternal puncture. The relationship of multiple lesions to solitary myeloma is noted. The frequent appearance of multiple lesions at some later date, after discovery of a solitary lesion, is stressed. An increasing number of cases with evident solitary lesions are found to be part of a generalized disease when the sternal marrow is examined. Repeated sternal punctures may be necessary.

It is felt that the myeloma cells arise from the reticulo-endothelial cells and develop through a dysplastic plasma-cell line. Sternal marrow spreads are more helpful in study of cell type than are fixed sections.

Among the patients who died, the average duration of the disease from onset of symptoms was 18.8 months; the longest survival was eighty-four months.

No effective treatment has been found to date.

L. A. POZNAK, M.D.
(UNIVERSITY OF MICHIGAN)

Treatment of Painful Spondylolisthesis. J. Puig Guri. Surg., Gynec. & Obst. **83:** 797–806, December 1946.

Diagnostic methods in spondylolisthesis have become pretty well established, but therapy still presents many undecided aspects. The surgeon must decide which cases are to be treated conservatively and which by spinal fusion, and, if the latter is the procedure of choice, which method should be used. The author mentions briefly various methods of surgical attack and compares statistically the results in a series of cases treated conservatively and by surgery; his figures favor surgery.

It is the author's opinion that those patients who have sciatic radiation of pain should be suspected of having intervertebral disk protrusion. In such cases he advises conservative treatment for a period of time, followed by exploration of the intervertebral disk in cases failing to respond to conservative methods. He feels such exploration should be done before a fusion of the posterior spine for the spondylolisthesis.

The pathology and management of those cases with degenerative changes in the disk associated with spondylolisthesis are discussed. Those with marked forward displacement of the superior portion of the vertebral column would fall into this group, and the author is of the opinion that the posterior spine should be fused in these in order to provide greater stability for the back. He believes anterior fusion is capable of providing permanent relief in mild cases of pure intervertebral disk disease.

The roentgenographic aspects of spondylolisthesis are reviewed and mention is made of the pseudospondylolisthesis of Junghanns, which is characterized by the dislocation of one vertebra upon another when there is not a preceding intense trauma or a separate neural arch. In these cases osteoarthritic change may be present at the apposing vertebral surfaces and the articular line of the inferior small articulation of the displaced vertebra tends to be more horizontal than the other articular lines. Most of these cases have been at the level of the 4th lumbar vertebra.

Comment on "reverse" spondylolisthesis is also included, as is mention of a few cases associated with scoliosis. The progression of the characteristic deformity of spondylolisthesis was observed and the conclusion reached that further slipping may occur at any time except in cases in which a buttress or osseous synostosis is present, but that cases of progression after puberty are of infrequent occurrence.

The author concludes with an interesting but brief commentary on the association of the etiology of spondylolisthesis with the anthropologic and ontogenetic development of the lumbosacral spine.

PAUL W. EYLER, M.D.

Spondylolisthesis: Additional Variations in Anomalies in the Pars Interarticularis. Maurice B. Roche and Charles S. Bryan. Arch. Surg. **53:** 675–682, December 1946.

The occurrence of spondylolisthesis in patients with unilateral spondylolysis and without rotation indicates the presence of other congenital defects to explain the mechanics. In spondylolisthesis with bilateral spondylolysis and in spondylolysis, unilateral or bilateral, without spondylolisthesis, no problem is posed, and these conditions are discussed very briefly. A case of unilateral defect on the left with slipping is presented, in which the presence of an intact right lamina of unusual length explains the mechanism. A case of reversed spondylolisthesis without spondylolysis is shown; in this patient the neural arch was unusually short and almost vertical in position. The author feels that in cases of slipping without spondylolysis or with a unilateral defect such factors should be investigated. For a complete understanding of the exact nature of the anatomic variations, oblique as well as anteroposterior and lateral projections should be included in the roentgenographic study of disability low in the back. In cases of unilateral congenital spondyloschisis, without symptoms before injury to the lower part of the back, oblique views may reveal a recent fracture of the previously intact side. In cases of questionable symptoms, stereoscopic views are valuable.

[An illuminating article.—L. G. J.]

LEWIS G. JACOBS, M.D.

Diagnosis of Root Compression. J. E. W. Brocher. Schweiz. med. Wchnschr. **76:** 1325–1329, Dec. 28, 1946.

Five types of root compression may be distinguished: posterior disk hernia, destructive infection (spondylitis), osteolytic neoplasm, primary intraspinal tumor, and separation of the posterior margins of the vertebral bodies. Since both require laminectomy, differentiation between intraspinal tumor and disk hernia is of little importance, but it is very important to distinguish between these and other conditions. Of the positive or suggestive physical signs, exacerbation of pain by sudden shaking of the back or by sudden elevation of the spinal fluid pressure (as in coughing, sneezing, laughing, or defecation) is important. Hyperextension in plaster will relieve this in disk herniation and at times in spondylitis, but not in intraspinal tumor. Pain and muscle spasm may result in a characteristic posture. Palpation of the spine is important, since it may localize a sudden reversal of curve. Stiffness on motion and local spasm are important, especially if hyperextension is painful. Positive neurologic findings are useful, but their absence is of no significance. Hypesthesia and reflex changes are especially important. The course of the disease must be considered; a sudden beginning, with a trauma as a rule, a month- to year-long course, and refractoriness to therapy are typical. The spinal fluid will show elevation of the albumin in cord tumor and in 50 per cent of disk hernias. The most consistently positive findings are obtained by iodide myelography—up to 90 per cent according to most authors. Air or carbon dioxide are not advised. Study of the sacroiliac joints must not be neglected, since disease here may cause similar symptoms. Oblique views of the spine to exclude spondylolysis and to study the posterior articulations are necessary. Roentgen findings must always be evaluated in the light of the clinical picture.

LEWIS G. JACOBS, M.D.

Arrest of Growth of the Epiphyses. John T. Hodgen and Charles H. Frantz. Arch. Surg. **53:** 664–674, December 1946.

The arrest of epiphyseal growth to correct unequal length of the legs leads to better results with increased experience. Energetic handling and early operation are desirable. Blount's operation, the use of removable staples to arrest the growth, is a marked technical improvement. It is in determining the optimum time for operation that most difficulty is experienced. The amount of discrepancy in length is first determined, best by use of x-ray; wood blocks to level the pelvis or a film showing pelvic tilt may be used, and teleroentgenography and slit scanography have been successfully employed. When the shortening has been measured, the ratio (shortening present)/(expected growth) gives the percentage of growth to eliminate, and the proper epiphysis to correct this may then be chosen from standard tables giving the percentage of the limb growth contributed by each epiphysis. Of 21 patients operated upon by these authors, 10 showed a gain, *i.e.*, a decrease in discrepancy, of 75 to 100 per cent; 10 a gain of 25 to 75 per cent, and only 1 less than 25 per cent gain.

LEWIS G. JACOBS, M.D.

Fractures of the Os Calcis. Their Treatment by Tri-Radiate Traction and Subastragalar Fusion. R. I. Harris. Ann. Surg. **124:** 1082–1099, December 1946.

Management of fractures of the os calcis is difficult because: (1) standardization of treatment is nearly impossible; (2) the technical problems involved in reduction of the fragments are complex and difficult; and (3) involvement of the subastragalar joint with late disability from pain on movement is frequent. As in other fractures, success in treatment is based on reduction of the fragments to as nearly perfectly normal relationship as possible. While restoration of the critical angle is an index of restoration of the fragments, of greater importance is the state of the posterior facet of the subastragalar joint.

Harris distinguishes between simple and severe fractures of this bone. For severe fractures he recommends tri-radiate traction supplemented by leverage with a Steinmann pin in certain cases. Kirschner wires are passed (*a*) through the upper end of the crest of the tibia, (*b*) through the posterosuperior angle of the os calcis, and (*c*) through the distal ends of the fifth and first metatarsals. Tri-radiate traction is applied and the results are checked roentgenographically. If they are unsatisfactory, adjustments are made and the results rechecked. When a lateral roentgenogram shows satisfactory restoration, the widening of the os calcis is reduced by molding pressure from either side. From a study of the post-reduction film, a decision is reached upon the necessity for subastragalar fusion. The criterion for this decision is the degree of fragmentation and deformity of the articular surface of the posterior facet of the os calcis. If the reduction is satisfactory, plaster is applied and the traction is removed as soon as this is thoroughly dried. Cases which are judged

suitable for subastragalar fusion are operated upon ten days after the primary reduction, as early fusion saves time and makes possible early return to work. Harris' results with this plan of treatment are satisfactory.

ELLWOOD W. GODFREY, M.D.

Talonavicular Synostosis. Fred G. Hodgson. South. M. J. **39:** 940–941, December 1946.

This is a brief report of a case of congenital bilateral talonavicular synostosis in a woman of thirty, with symptoms first appearing after an increase in weight. Examination of a sister of the patient showed an exactly similar condition. A daughter was found to have normal tarsal bones.

GYNECOLOGY AND OBSTETRICS

Use of Radiology in Predicting Difficult Labor. J. Chassar Moir. J. Obst. & Gynaec. Brit. Emp. **53:** 487–497, December 1946; **54:** 20–33, February 1947.

The first of the two lectures appearing under the title given above is subtitled "Introduction: Technical Considerations in Pelvimetry and Cephalometry."

"Too often," says the author, "there has been a lack of co-operation between the radiologist and the obstetrician so that neither fully appreciated the needs and difficulties of the other, and secondly, there was—and, I believe, still is—too much reliance placed on what might be termed an impressionistic interpretation of the radiograph, with opinions based on general appearances rather than on precise data concerning the dimensions of the maternal pelvis on the one hand, and the fetal head on the other." Although he is himself an obstetrician, he has actually taken over the radiological examination in order to evaluate for himself the various methods of pelvimetry. He does not, however, recommend this dual role to obstetricians in general. His studies now cover nearly 800 cases.

Interestingly enough, the author suggests that all projections of the pelvis should be made at a distance of not less than 4 feet; if a Bucky diaphragm is used, 4 1/2 feet should be a minimum. The use of the erect position for the lateral projection is advised, and an ingenious rack is described for immobilizing the patient rather comfortably. A support has also been devised for the patient for the supero-inferior projection. The method of recording the marker on the supero-inferior projection of the pelvis is rather ingenious; a half circle wire loop is used to hold the marker behind the patient tilted at the same angle as the sacrum. The "corrected centimeter" scale is incorporated on the film with the curved wire.

The pubic arch is projected onto the film by a posterosuperior-antero-inferior projection, with the patient sitting on a specially constructed box with an oblique slot to hold a cassette for a 6 × 4-inch film. This, it is believed, gives a more accurate recording of the subpubic arch.

Cephalometry, when the fetus is in the breech position, is done by incorporating a scale measurement on a tangential view of the fetal head, which is located by palpation. If one is to estimate the growth of the fetal head after the film is made, in relationship to the projected date of delivery, one should consider that the head grows about 2 mm. per week. The effect of molding on the biparietal diameter is discussed.

To this first lecture the author appends an addendum rebutting a criticism of brim pelvimetry by Heyns (J. Obst. & Gynaec. Brit. Emp. **52:** 148, 1943).

The second lecture—"Forecasting the Course of Labor"—is introduced by an enumeration of six features of a "good obstetric pelvis" and a discussion of Nicholson's area measurements and Thoms' early work on pelvic charts. The author then proceeds to his own graph method, which he designates the "focal point" of the two papers. This is based on a consideration of the anteroposterior and transverse diameters of the brim, the pelvic cavity at the level of the ischial spines, and the outlet. The conception of the diameters of the brim is somewhat at variance with the orthodox teaching. Moir believes that the promontory of the sacrum is not usually the important posterior landmark. Instead he takes as the anteroposterior diameter the shortest distance between the upper and inner margins of the symphysis pubis and the nearest part of the sacrum, as a rule the junction of the first and second sacral segments or a point between that and the promontory. The transverse diameter he defines as that which intersects the conjugate of the brim at the midpoint. The lower anteroposterior measurement of the pelvic cavity is taken from the nearest point of the inner margin of the symphysis pubis to the tip of the sacrum or, if the coccyx is fused with the sacrum, to the first free intercoccygeal joint. This must sometimes be discovered clinically rather than by x-ray examination alone. The transverse diameter of the pelvic cavity is reckoned as the distance between the ischial spines. The outlet is best estimated by measuring the subpubic angle and using this measurement in conjunction with the posterior sagittal dimension of the outlet.

In the evolution of the graph method, three types of graphs were prepared, one for the brim, one for the cavity, and one for the outlet. In each, the anteroposterior dimensions were marked vertically and the transverse dimensions horizontally. By pin-pointing a spot on each of the three graphs, the main facts regarding the size and shape of any particular pelvis could be recorded. Separate sets of three graphs were made for each size of the fetal head from 9.0 to 9.9 cm., biparietal diameter, that is, ten sets of graphs in all. All the data from some 800 cases with the criteria of easy spontaneous delivery and difficult labor as judged clinically were spotted on these graphs. Having marked out the dividing line on each individual chart, it was then possible to combine the charts and to draw up a single set of three charts showing the dividing lines for easy and difficult deliveries for each size of fetal head. These are now the key charts on which it becomes an easy matter to pinpoint any pelvis and to determine its obstetric value relative to the estimated size of the fetal head.

The series of cases on which these graphs are based included a large number with a high head at term or other clinical evidence of disproportion. From some points of view this is an advantage, but the excessive proportion of borderline cases makes the material unsuitable as a fair test of the value of the graphs in indicating the probable course of labor in the general run of cases. A number of cases of dystocia not due to cephalopelvic disproportion were also included—a group in which there is no way of absolutely predicting the course of labor.

The prediction of dystocia is surest when a fault is revealed in the brim graph, and considerable weight should therefore be given to such evidence.

The following blind spots in the graph technic are enumerated: (1) a high inclination of the pelvic brim, which, if there is already some tendency to disproportion, influences the prognosis unfavorably; (2) lack of a normal full curve of the sacrum from above downwards, giving a lessened posterior sagittal diameter and thereby accentuating any tendency to disproportion; (3) malposition of the head.

Radiology has been found to be especially useful under the following conditions: (1) a high head at term and suspected pelvic contraction; (2) abnormal or prolonged labor; (3) postmaturity and prematurity (cephalometry helps in predicting the degree of maturity of the fetus more than any other single criterion); (4) breech presentation, when the head cannot be engaged directly against the pelvic brim; (5) suspected hydrocephalus; (6) necessity of deciding whether a patient can be safely delivered at home; (7) previous difficult labor; (8) fear of obstetric delivery.

Certain criticisms which have been brought against obstetric radiology are refuted, and the paper concludes with the statement that good obstetrics requires sound clinical judgment, which depends on observation and appreciation of diverse clinical features, a part of which is radiology. SYDNEY F. THOMAS, M.D.

The Pelvic Survey. Herbert Thoms. Yale J. Biol. & Med. **19:** 171–179, December 1946.

This article is truly a pelvic survey in so far as it defines the points of view of the obstetrician and the radiologist and correlates the two in arriving at a useful method of applying pelvic measurements from roentgenograms to the clinical survey. It is pointed out that it is necessary not only to make the measurements, but also to relate these measurements to the shape of the pelvis and the clinical measurements and appearances.

The author quotes from a previous article (Thoms and Schumacher: Am. J. Obst. & Gynec. **48:** 52, 1944): ". . . we wish to observe that midplane pelvic contraction, as indicated by shortening of the transverse diameter, combined or not with shortening of the midplane anteroposterior diameter, is definitely associated with increased operative intervention during labor. When the midplane is 9.5 cm. or less and other diameters remain in average limits, according to this study, the incidence of intervention was 45.2 per cent. When midplane anteroposterior shortening was also present, operative incidence was 65.0 per cent."

The essential diameters of the pelvic inlet are:

I. The anteroposterior diameter, extending from a point on the upper posterior surface of the symphysis pubis, 1 cm. from its superior border, posteriorly to the anterior surface of the sacrum to the point where the iliopectineal lines would meet were they extended.

II. The transverse diameter, being the widest distance separating the iliopectineal lines.

III. The posterior sagittal diameter, being that portion of the anteroposterior diameter which lies posterior to its intersection with the transverse diameter.

The essential diameters of the midplane are:

I. The anteroposterior diameter, extending from the lower posterior border of the symphysis posteriorly at the level of the ischial spines to the lower third of the sacrum, usually falling at or near the junction of the fourth and fifth sacral segments.

II. The transverse diameter, being the narrowest distance separating the ischial spines.

III. The posterior sagittal diameter, that part of the anteroposterior diameter which lies posterior to its intersection with the transverse diameter.

For achieving these measurements two views of the pelvis are recommended: the conventional anteroposterior projection of the pelvis (which really amounts to a projection looking down into the pelvic space) and a true lateral projection, made in the upright position. Both films are made at a distance of 36 inches. In the anteroposterior projection, the perforated grid is superimposed on the film at the same level as the symphysis. The importance of the subpubic angle is belittled. The medical judgment of the outlet is in the author's experience more useful than any attempt at a judgment of the adequacy of the outlet from the roentgenogram.

In conclusion, the author states, "It must be reemphasized that, even with the availability of this increased knowledge of pelvic morphology and dimensions, the problems of childbirth still remain manifold and complex and must be viewed in their entirety in the scientific conduct of labor."

SYDNEY F. THOMAS, M.D.

THE GENITO-URINARY SYSTEM

A New Technique of Perirenal Air Insufflation. Francisco J. Barquin. J. Urol. **57:** 1–14, January 1947.

The author conceived the idea of inserting the needle for perirenal air insufflation through the line of incision used for exploration of the kidney. The patient is placed in the usual lateral position for exploration of the flank, with maximum elevation on a Pillet support to open the costo-iliac space and displace the peritoneum and intestines. After the usual sterile preparations, a large spinal puncture needle is introduced through the skin at the junction of the proximal two fourths of a line drawn from the costovertebral angle to the anterior superior iliac spine. The needle is directed upward and inward toward the spine and diaphragm and inserted until it touches the kidney, at which time the hub of the syringe will move up and down with inspiration and expiration.

Before injecting each syringeful of air the blood pressure is taken. The author has found a drop of blood pressure in every case, sometimes reaching a maximum of 70 mm. systolic, but this is easily controlled by central and peripheral stimulants. The diastolic pressure does not usually fall more than 5 to 10 mm. It is believed that a fall in systolic pressure may be responsible for some of the serious accidents reported by certain urologists as due to gas embolism.

Before the first air is injected, 5 c.c. of normal saline are introduced through the syringe to separate the kidney cortex from the tip of the needle. Aspiration is then done to make sure that a blood vessel has not been entered. Thirty cubic centimeters of air are injected at a time for a total of 600 to 900 c.c., according to the patient's tolerance.

Fourteen case reports are presented, with good reproductions of roentgenograms made following air insufflation. VERN W. RITTER, M.D.

Differential Diagnosis of Surgical Renal Lesions. Meredith F. Campbell. Am. J. Surg. **72:** 786–799, December 1946.

The differential diagnosis of surgical renal lesions is here considered, including chronic pyelonephritis, in-

fected hydronephrosis, renal tuberculosis, calculus, tumor, acute renal infection and congenital malformation. Diagnosis is difficult, since practically all renal diseases may present a similar clinical picture. In all cases, careful urinalysis of a properly collected specimen is of greatest diagnostic importance. Cure of urosurgical conditions implies a restoration of urine to normal, including sterilization of the urine as attested by at least two negative cultures.

In *surgical non-tuberculous renal infections* the usual lesion is an interstitial suppurative nephritis which may exist alone or as a complication of a stone or obstruction. In acute renal infections, failure of intensive medical therapy to bring marked improvement in three to four days calls for complete urologic examination. This will usually reveal infected hydronephrosis, generally due to pelvic outlet or upper ureter blockage by stone, stricture, malposition, aberrant vessel, or perirenal abscess. Also there may be a renal carbuncle or a pyemic kidney.

Any retroperitoneal edema-producing lesion, as a perinephric abscess, will roentgenographically obscure the ipsilateral psoas muscle shadow and usually show lumbar curvation away from the lesion due to compensatory spasm of the ipsilateral erector spinae group. This picture, along with acute intra-abdominal disease with unilateral renal area tenderness and a history of recent cutaneous infection, suggests perinephric abscess. Yet retrocecal appendicitis and edema may produce the same picture and would be favored by the urographic demonstration of a normal upper urinary tract. Also, the same picture is presented by the rare renal infarction, or thrombosis, but this occurs most often in infants or the young and is associated with more acute onset and variable shock and prostration.

Chronic surgical urinary infection with persistent pyuria despite medical therapy demands urologic examination, which often discloses chronic pyelonephritis, complicated by or associated with infected hydronephrosis, ureteral obstruction, calculus, tuberculosis, or malformation. In half of these cases reflex or toxic gastro-intestinal symptoms lead the diagnosis away from the basic urinary tract lesion. With these vague symptoms, the urinary tract must not be overlooked.

The multiple causes of *hydronephrosis* stem from lesions anywhere in the urinary tract from calyx to meatus and include strictures (congenital and inflammatory), stones, adjacent abscesses or tumors, intrinsic muscle spasm, mucosal folds, vascular obstruction, and neuromuscular vesical disease. The need for thorough urologic examination to identify the site and nature of the obstruction in any given case is at once apparent.

Pyonephrosis is usually the end-result of infected hydronephrosis, stone, or tuberculosis, and here the kidney is destroyed. Pyuria, hematuria, pain, and a mass in the side suggest pyonephrosis, with final diagnosis by urographic means. The roentgenographic appearance of the pelvic outline may simulate that of renal tuberculosis, but in pyonephrosis, secondary vesical inflammation is unusual.

Renal tuberculosis is always secondary and is to be suspected in any case of cystitis existing over one month. In 80 to 90 per cent of cases tubercle bacilli are demonstrable by acid-fast stain of centrifuged sediment. The initial picture includes pain, pyuria, vesical irritability, intermittent hematuria, and low-grade fever. Pyelography, excretory or retrograde, will indicate renal tuberculous fibrosis, either local or widespread parenchymal ulceration, commonly with cavitation and heavy calcium infiltration, and sometimes perirenal disease as well.

Pain in the renal area or along the course of the urinary tract, together with gross or microscopic hematuria and pyuria, are classic symptoms of *renal calculus*. A large immobile pelvic stone may be "silent." Urography usually establishes the diagnosis.

Painless fresh hematuria most often means *tumor* in the adult and nephritis in the child. Accurate preoperative diagnosis of renal tumor requires urography. Retrograde pyelography is here preferable since changes in the finer pelvic markings are of paramount importance. The pelvic outline is usually distorted, with compression and elongation of the calices. Filling defects sometimes occur in the pelvis from papillary growths.

Surgically, the most important *renal malformations* are agenesis, hypoplasia, reduplication, ectopia, fusion, cystic kidneys, and abnormal motility. Abdominal pain, a palpable mass, and abnormal urinalysis direct attention to the urinary tract. Renal malformations often accompany major deformities of the external genitalia. In all these malformations, the correct diagnosis can almost always be made by urography. The anomalous kidney is more prone to disease than the normal one. Congenital absence and aplasia should be recognized, so that the solitary functioning kidney is not unwittingly removed. Roentgenograms should be made with the patient in the Trendelenburg position as well as upright, to detect abnormal motility. In polycystic disease, the pyelogram shows a notable tendency to crescent-like dilatation of the major calices.

DOUGLAS R. NAGLE, Jr., M.D.

Non-Fused Pelvic Kidney: A Study of Nine Cases. Ralph L. Dourmashkin. Urol. & Cutan. Rev. **50:** 712–719, December 1946.

Nine cases of non-fused kidney occupying either the true pelvic or the lumbo-ilio-pelvic position are recorded. Concerning the roentgen diagnosis of this anomaly, the author says that frequently the pelvic kidney is not demonstrable on a plain film or even in an intravenous pyelogram, either because the dye shadow is superimposed upon the pelvic bone shadow or because of poor dye elimination. In only 2 of the cases in this series did the plain film show a definite outline of a pelvic kidney. This anomaly should be suspected, however, in any case in which a plain film fails to show the normal renal silhouette.

In 6 of the series, intravenous pyelography was done and in none was the renal ectopia demonstrated. In one case, after the presence of a pelvic kidney was ascertained by retrograde pyelography, a persistent narrow streak of dye was observed in the intravenous pyelogram over the iliac bone, but this had previously been overlooked. In another, a hardly perceptible shadow of the ureter traversing the soft portion of the pelvis was a suggestive sign.

Retrograde pyelography established the diagnosis in 8 of the cases. Mention is made of Scarcello's suggestion (J. Urol. **50:** 25, 1943. Abst. in Radiology **42:** 519, 1944) that films be made with the patient prone and the x-ray tube directed at about a 45° angle to the lower outlet of the pelvis, thus projecting the shadow of the dye-filled renal pelvis away from the sacrum, but the author does not consider this necessary.

The congenital anomaly of non-fused pelvic kidney is

to be differentiated from a ptosed kidney, renal agenesis, an abdominal neoplasm, diseases of the lower abdominal organs, and megalo-ureter.

MAURICE D. SACHS, M.D.

THE BLOOD VESSELS

Unusual Venous Returns of the Lower Extremities. E. C. Baker. Am. J. Roentgenol. **57:** 50–55, January 1947.

The venous channels which may be visualized in the normal venogram of the leg and thigh are described. The internal saphenous vein is the normal main channel for the superficial portion of the system. The tibial veins unite with the peroneal veins to form the popliteal, which becomes the femoral vein above the popliteal space. These are the deep channels. In the fossa ovalis the internal saphenous vein and the femoral vein unite to form the external iliac vein.

In acute block of the main deep physiological channel of the thigh, the injected dye seeks numerous small veins below the site of the block. These veins form a lacy network in the superficial tissues. Following such an acute block, nature gradually finds larger channels in the area of the block so that in a few weeks to several months certain main physiological channels are formed out of already existing veins, and these become the main channels for the blood stream in blocks of long duration. Usually the blood flow through these veins is now reversed and the injected dye extends outward from the region of the fossa ovalis through them to collateral circulation where normal upward channels are reached. Cases are presented, with illustrations, of acute deep block in the thigh, chronic deep block of the thigh with return through the pudendal circulation, chronic deep block with return through circumflex veins, and with return through perineal veins and mid-sacral veins. Another case is shown in which a block occurred in the region of the fossa ovalis with partial return through the inferior gluteal vein.

When unusual types of return are visualized in the region of the fossa ovalis or upper thigh, it is concluded that this is conclusive proof of a deep block.

CLARENCE E. WEAVER, M.D.

RADIOTHERAPY

Results of Radiotherapy of Epibulbar Tumors at Radiumhemmet, Stockholm, 1920–1940. Harry Larsson. Acta radiol. **27:** 358–373, May 6, 1946.

During the period 1920–40, 66 cases of epibulbar neoplasms—*i.e.*, neoplasms in the conjunctiva on the anterior side of the bulbus oculi—were treated. For the most part, treatment was by surface application of a weakly filtered radium preparation, but the more advanced malignant tumors received roentgen therapy in high dosage. "Plane preparations" of radium were used, containing 10 and 5 mg. of radium element, respectively. The radium sulfate is fused into a porcelain plate 1.0 × 1.0 or 1.0 × 0.5 cm., and the rays are filtered through 0.2 mm. of nickel or German silver.

Of 37 patients with growing epibulbar tumors which were without histologic or clinical evidence of malignancy, 30 were completely free of symptoms for five years or more after treatment. Of 7 nevogenic tumors in which it was impossible to exclude malignancy histologically, 6 were symptomless after five years or more. In 5 of these cases extirpation of the tumor preceded irradiation. Of 14 patients with a histologic diagnosis of malignant melanoma, 7 survived five years or more after a combination of surgical and irradiation therapy. Two patients had papillomas of suspected malignancy, and one of these was free of recurrence at the time of his death from pneumonia five and a half years after treatment. Four of 6 patients with squamous-cell carcinoma were without symptoms for five years or longer.

The author considers preoperative irradiation the method of choice for localized epibulbar tumors, with subsequent extirpation or a more radical surgical procedure only when there has been a radioresistant recurrence or the primary tumor has failed to regress.

Radiation injury to the eye occurred in 5 cases, 4 of which had received heavily filtered radium applications or roentgen irradiation. The one patient in this group who was treated by means of the superficial plane applicator was a one-year-old girl. The pea-sized nevus disappeared completely, but six years after treatment clouding of the cornea occurred and was attributed to the irradiation.

ELIZABETH A. CLARK, M.D.

Case of Cancer of the Oesophagus, Alive and Free from Evidence of Tumour 6 Years after Roentgen Treatment. Folke Jacobsson. Acta radiol. **27:** 351–357, May 6, 1946.

A 58-year-old man had experienced difficulty in swallowing for about a year before hospital admission. Roentgen examination revealed a tumor in the lower esophagus, shown by biopsy to be a squamous-cell carcinoma. Treatment was by roentgen irradiation, an estimated tumor dose of about 5,000 r being administered by cross-firing through six fields in a period of thirty-five days. The patient tolerated treatment well and improvement was noted during the period of hospitalization. Cardiac symptoms with cardiac enlargement and pleural effusion developed within three months and were regarded as a radiation effect. Nevertheless, the patient was alive and well without evidence of recurrence or metastases six years after treatment and with only mild cardiac disturbance. Esophagoscopy showed no evidence of tumor.

ELIZABETH A. CLARK, M.D.

Roentgen Therapy of Lung Tumors. Sordello Attilj. Radiologia (Rome) **1:** 81–85, 1945.

The author treated with roentgen therapy 25 primary lung tumors and 23 metastatic lesions of the lungs. Of the 25 patients with primary tumors, only 2 were well at the end of two years, but the local symptoms and general well-being of the patients improved in 60 per cent of cases. Of the 23 with metastatic lesions, only 1 was still alive at the end of one year and only 5 were subjectively improved. The author used 180 kv., 10 ma., 0.5 mm. Cu plus 3.0 mm. Al, 200 to 300 r daily until a tumor dose of 4,000 to 8,000 r had been reached.

In view of his results, Attilj concludes that roentgen therapy should be tried in those patients with primary lung tumors which are not susceptible to surgical treat-

ment because of the subjective improvement. If the lesions are metastatic, such an improvement can be expected only in a limited number of cases.

CESARE GIANTURCO, M.D.

Regression of the Changes of Pulmonary Osteoarthropathy Following Treatment of the Primary Lung Conditions. Adamo Grilli. Radiologia (Rome) **1:** 21–45 1945.

The author reports 3 cases of pulmonary tumors with osteoarthritic manifestations, severe periosteal reaction, and hypertrophy of the phalangeal soft tissues. Two of the patients were given roentgen therapy and one underwent lobectomy. Following treatment, the osteoarthritic and soft-tissue alterations underwent notable regression in all cases.

CESARE GIANTURCO, M.D.

Effect of Estrogenic Hormone on Advanced Carcinoma of the Female Breast. Julian B. Herrmann, Frank E. Adair, and Helen Q. Woodard. Arch. Surg. **54:** 1–9, January 1947.

Seventeen patients with carcinoma of the breast (13 primary inoperable; 4 recurrent) were treated by ora administration of ethinyl estradiol, a synthetic estrogenic hormone, receiving daily doses of 0.15 to 0.7 mg. over periods of two to eleven months. Eight died (one of intercurrent disease) within eighteen months; 7, including 2 with pulmonary metastases, showed some clinical improvement, and 1 showed cytologic changes of degeneration in the tumor without clinical improvement. Uterine bleeding was induced in 8 patients, amounting to a serious hemorrhage in 1. A favorable response occurred predominantly in women past 60; in younger women, especially in those not in the menopause, the effects were deleterious.

LEWIS G. JACOBS, M.D.

Corpus Carcinoma: A Study of Three Hundred Twenty-Two Cases. Norman F. Miller and Charles W. Henderson. Am. J. Obst. & Gynec. **52:** 894–900, December 1946.

A comparative study is presented of 322 cases of corpus carcinoma treated by various methods. A "preferred program" was followed which was instituted in 1931, based on the following assumptions: (1) that elimination of the primary neoplasm could probably best be achieved through complete surgical extirpation of the entire uterus, tubes, and ovaries; (2) that, theoretically, supplemental irradiation should be most beneficial when given prior to surgery, causing widespread damage to cancer cells, minimizing manipulative spread at operation, and causing some obliteration of the lymphatics. Since radiation was not depended upon for the destruction of the primary lesion, but for its damaging effects on the outlying cancer cells, it was decided that x-ray therapy followed by adequate surgery should be the treatment of choice. X-rays were preferred to radium in the belief that with the broader fields affected by x-ray some damage to neoplastic cell masses in the tubes and ovaries might occur. During the fourteen and a half years that this program has been pursued the following results were obtained:

1. Of 37 patients treated with radium alone, 41.3 per cent obtained a five-year cure and 30 per cent a ten-year cure.
2. Of 32 patients treated with x-rays alone, 27.2 per cent obtained a five-year cure, 16.6 per cent a ten-year cure.
3. Of 89 patients treated with x-rays and radium, 28.0 per cent obtained a five-year cure, 23.0 per cent a ten-year cure.
4. Of 20 patients treated with surgery alone, 53.3 per cent obtained a five-year cure, 50.8 per cent a ten-year cure.
5. Of 16 patients treated with radium and surgery, 86 per cent obtained a five-year cure, 81.8 per cent a ten-year cure.
6. Of 96 patients treated with x-rays and surgery, 77.0 per cent obtained a five-year cure, 65.0 per cent a ten-year cure.
7. Of 11 patients treated with x-ray, radium, and surgery, 66.6 per cent obtained a five-year cure, 60.0 per cent a ten-year cure.
8. Twenty-one patients received no treatment.

Additional tables are presented showing the histologic grading and clinical grouping of the cases treated.

The authors conclude that preoperative x-ray therapy has proved to be a valuable adjuvant to total hysterectomy and bilateral salpingo-oophorectomy. It clears up uterine infection, reduces uterine size, and decreases pelvic hyperemia. Radium likewise gives good results, but on the basis of the available data the relative merits of x-ray versus radium cannot be accurately stated.

PHILIP W. DORSEY, M.D.

Dysgerminoma of the Ovary. A Review of Eleven Cases of Proved Tumor, with Special Reference to Radiosensitivity. Robert D. Moreton and Arthur U. Desjardins. Am. J. Roentgenol. **57:** 84–90, January 1947.

In general the majority of investigators believe that dysgerminoma is derived from embryonic sexual cells as a result of some undetermined stimulus. A few believe with Ewing that the tumor is an atypical teratoma; other workers accept Fischel's (Ztschr. f.d.ges. Anat. (Abt.1) **92:** 34, 1930) theory, according to which the origin of the lesion is related to totipotential mesenchymal cells.

Ewing (Neoplastic Diseases, Philadelphia, W. B. Saunders Co., 4th Ed., 1940, pp. 661–662) wrote: "It is a malignant, radio-sensitive, cellular tumor occurring at rather early ages, lacking hormonal effects, composed of large polyhedral cells of embryonal type, and lying in a loose stroma containing many lymphocytes." The prognosis is relatively good in those instances in which the neoplasm is unilateral, encapsulated, and nonadherent. Results of recent studies have shown that dysgerminoma may be associated with an excess of anterior pituitary-like substances in the urine.

Since the tumor ranks next to lymphoblastoma in radiosensitiveness and since treatment with roentgen rays generated at high potentials may injure unaffected abdominal structures, the treatment in the authors' series has been carried out largely with roentgen rays generated at 130 kv. (constant potential) usually filtered through 6 mm. of aluminum. Four anterior (abdominal) fields which extend from the xiphoid cartilage to the pubic bone are used, as well as four corresponding posterior fields. The left supraclavicular space is also irradiated. The surface of each field receives 540 r in air. The treatment is repeated in a month. Subsequent treatment is governed by the results of periodic examinations. The treatment which

offers the best prospect of longevity is surgical removal of the tumor plus adequate postoperative therapy. Four cases of dysgerminoma of the ovary are reported in detail in this paper. CLARENCE E. WEAVER, M.D.

Carcinoma of the Vulva. Results of Treatment and Effect of Special Factors on Results. Frank R. Smith and Robert S. Pollack. Surg., Gynec. & Obst. **84:** 78–84, January 1947.

Two hundred and twenty-eight histologically proved cases of carcinoma of the vulva treated at the Memorial Hospital, New York, during a twenty year interval (1926–45) are reviewed as to results of treatment and the effect of special factors on results.

The authors divide their cases into three general groups: (1) cases without involvement of inguinal nodes, (2) cases with inguinal nodes involved but operable, and (3) inoperable cases with inguinal nodes fixed or immobile. Their statistics show a marked difference between results in the early low-grade lesions and those which have become metastatic and invasive. They indicate that those patients who have received vigorous and prompt treatment do the best. They are in favor of vulvectomy with at least a bilateral superficial groin dissection in all cases suitable for surgery. Although only a relatively small proportion of the operable cases were treated by radiation, the authors are of the opinion that x-ray and radium are inadequate for treating either the primary or any locally metastatic lesion.

The authors state that carcinoma of the vulva accounts for only 4 per cent of all cancers of the female genital tract. In their series the youngest patient was 27, the oldest 89, with the majority between 50 and 69 years of age. Eighty-four per cent of the patients had an epidermoid type of carcinoma. The absolute five-year cure rate was 26 per cent.

MARLYN W. MILLER, M.D.

Carcinoma of the Bladder: A Classification of Epithelial Tumors and a Study of the Effects of External Radiation. Fletcher H. Colby and Ronald C. Sniffen. J. Urol. **57:** 133–139, January 1947.

A microscopic and clinical study of bladder carcinoma is presented in an effort to correlate the histology of these tumors with response to x-ray therapy. The Massachusetts General Hospital classification and Broders' method of grading were used, the tumors being divided into papillary and non-papillary, the former graded 1A, 2A, and 3A and the latter 1B, 2B and 3B, according to malignancy. The histologic factors upon which the grading is based are described in detail.

The morphology of 26 tumors observed remained constant throughout treatment except for one or two papillary lesions which invaded the bladder wall and became non-papillary. These tumors were observed before and after therapy for histologic changes. The authors conclude that the diagnosis of "radiation reaction" on a histologic basis is not practicable, as two such diagnoses were made prior to therapy and in the remaining tumors there was no constancy in post-irradiation features.

A total of 130 tumors of the bladder treated with a 1,200-kv. unit were studied; some were given 7,200 to 8,400 r in doses of 300 to 400 r per treatment and some received 6,000 r in doses of 300 r per treatment. Additional courses of 2,400 r to 4,800 r were given in some instances. It is not stated whether these are tumor doses or air doses.

One hundred and eleven cases were classified and graded. In these cases no definite correlation was found between histology and response. Papillary and non-papillary tumors responded equally well, showing regression in one-third of cases, while symptoms were relieved in about one-half. PAUL R. NOBLE, M.D.

Results of Treatment with Radiotherapy in Carcinoma of the Prostate. Sven Hultberg. Acta radiol. **27:** 339–350, May 6, 1946.

The author has analyzed the cases of prostatic carcinoma treated by irradiation at Radiumhemmet between 1929 and 1940. Of the total of 167 cases, 107 were inoperable and were treated by irradiation alone; 46 were referred for postoperative irradiation; and 14 patients were seen only after recurrence or metastases had developed. Seventy cases received roentgen irradiation; 25 received teleradium therapy, and 65 a combination of the two. Of the remainder, 3 received such small amounts that no evaluation can be made, and 4 were treated with implantation of radium needles. In no case was an attempt made at castration.

The percentage of five year survivals was appreciably higher for the group receiving teleradium therapy, either alone or combined with roentgen irradiation. In evaluating this survival rate, the author stresses the fact that, despite careful attempts to protect the testicles during teleradium treatment, they probably received a dose of about 350 to 500 r, while with roentgen therapy the dosage to the testicles was negligible. In general, also, the dose to the prostate was greater with teleradium.

In 105 patients metastases were present. Of the 82 patients with skeletal metastases, the majority experienced relief of pain from roentgen therapy. The period of good palliative result varied from a short time to as long as two years in a few patients. The average duration of survival after the discovery of metastases was 12.9 months. ELIZABETH A. CLARK, M.D.

Three Cases of Testicular Tumor. John A. Taylor. J. Urol. **57:** 175–184, January 1947.

Three rather unusual examples of testicular tumor are presented, in which a combination of surgery and roentgen therapy was used and long-term survivals were achieved. The pathological aspects are documented in detail, but only scant descriptions are given of the roentgen technic. Inguinal excision with preoperative and postoperative roentgen irradiation is recommended as assuring the best prognosis in such cases.

The first patient had a seminoma of the right testis discovered incidentally in an examination for sterility. Five years after orchiectomy and postoperative roentgen therapy the opposite testis was found to be involved. A diagnosis of seminoma was again made and similar treatment was given. The patient is reported to be in good health nineteen years after the first operation. Testosterone was administered periodically following the second orchiectomy, and with gratifying effects.

In the second case, five months after operation and postoperative irradiation for a teratoma of the left testis, a metastatic mass was found in the abdomen. This disappeared following irradiation. Twelve years later, a seminoma was discovered in the remaining

testis. Like the original tumor, it was treated by surgery and x-rays. Two years after this another abdominal mass appeared, but it, too, yielded to irradiation. The patient is well fourteen years after removal of the first tumor.

In the third case, the diagnosis was chorionepithelioma, with an associated acne and gynecomastia. The involved testis was resected, radiation being given before and after operation. The acne and gynecomastia were strikingly improved following treatment, suggesting an hormonal origin. This patient is in apparent good health nine years after the tumor was discovered.

Excellent photomicrographs of the lesions in all 3 cases are reproduced. PAUL W. EYLER, M.D.

Boeck's Sarcoid (Sarcoidosis). Abraham Oppenheim and Robert S. Pollack. Am. J. Roentgenol. **57:** 28–35, January 1947.

Boeck's sarcoid is a generalized systemic disease with protean manifestations. In its tendency to affect many organs, it simulates the lymphomatous diseases. Chest roentgenograms show a bilateral symmetrical hilar enlargement. In spite of this, there is a paucity of respiratory symptoms and physical signs. Only one of the authors' series of 42 patients showed bone changes. It is concluded from this that bone changes are confirmatory signs only and that their absence should not preclude the diagnosis of Boeck's sarcoid. Biopsy of peripheral lesions or lymph nodes can establish a definite diagnosis. This was done in 27 of the authors' cases. The tuberculin test was negative in 64 per cent of the series. Involvement of the eye is comparatively common. Thirty-four of the patients showed chest manifestations, and in 20 of these there were peripheral manifestations also. In those showing chest lesions, cough was the most prominent symptom. Weight loss and dyspnea were the least common. One patient had a gastric ulcer which proved on pathological examination to be Boeck's sarcoid. Hodgkin's disease, because of the close resemblance of the chest picture and other clinical features, is the chief condition from which a differential diagnosis must be made.

In cases where symptoms are present, definite benefit is derived from the administration of small doses of roentgen radiation to the mediastinum and to peripheral nodes if the latter are palpably enlarged. Of 24 cases thus treated in this series, 20 have been observed sufficiently long to indicate that the prognosis of Boeck's sarcoid is favorable. Regression and complete disappearance of mediastinal and peripheral lesions have been noted after radiation therapy. Symptoms when present have usually abated.

CLARENCE E. WEAVER, M.D.

Herpes Zoster. Robert J. Reeves and L. Bradford Waters. Texas State J. Med. **42:** 490–491, December 1946.

After describing the incidence, pathologic physiology, and diagnosis of herpes zoster, the authors discuss the various known methods of treating the disease. Among these, roentgen therapy has been found to be effective. Keichline is quoted (Radiology **22:** 372, 1934) as having cured 90 per cent of 62 cases with a single treatment of 150 r through 3 mm. Al at 30 cm. distance. Reeves and Waters used a technic similar to that of Tuggle et al (Am. J. M. Sc. **200:** 803, 1940. Abst. in Radiology **37:** 257, 1941). Fifty-seven cases were treated. The factors employed were: 200 kv., 0.5 mm. Cu and 1 mm. Al, T.S.D. 50 cm. A daily dose of 200 r was administered for a total of 800 to 1,000 r. It was noted that the patients showing an immediate increase in pain following the first treatment responded more readily to the therapy. When symptoms had been of less than one week's duration, pain was relieved in seven to ten days. When symptoms had been present for more than twenty-nine days before treatment was started, failure or only partial improvement was noted. Of the total cases treated, 38 were cured, 10 were improved, and 8 were regarded as failures. STANLEY H. MACHT, M.D.

Treatment of Amenorrhea and Sterility by X-Ray Therapy. Ira I. Kaplan. New York State J. Med. **46:** 2746–2752, Dec. 15, 1946.

Kaplan points out that in 1926 Rubin reported x-ray therapy as a means of relieving sterility associated with habitual amenorrhea. In the same year, Hirsch (Radiology **7:** 93, 1926) reported favorably on x-ray treatment of ovarian hypofunction. Other reports followed and the author has himself reported two previous series. As a result of his treatment of 296 cases he is confirmed in his original view that radiation properly administered would be effective in a large number of cases of amenorrhea and sterility, without harm to mother or offspring. The possibility of harmful effects upon future generations cannot be ignored, but has not been demonstrated.

Whether the x-rays exert their effect directly upon the ovaries or upon the uterus or pituitary is not known. The author discusses the observations of numerous investigators and reports illustrative cases supporting various views. Without reaching any definite conclusion on the mode of action, he concludes that no other treatment thus far devised, including organotherapy, has yielded equally satisfactory results.

The treatment factors are 200 kv., 0.5 mm. Cu plus 1.0 mm. Al, 50 cm. distance. The pelvic fields include right and left, anterior and posterior, and vary from 8 × 10 cm. to 10 × 15 cm. The pituitary field is limited to a 6 × 8 cm. area. The dosage was 50 to 75 r (measured in air) per treatment, administered weekly for three weeks. Each time the pelvis was treated the pituitary was given a dose of 75 r. *The series is not repeated.*

The indications for x-ray therapy come only after every other method of treatment has failed and the gynecologist or consulting physician is qualified to judge that there is a possibility that roentgen therapy will be beneficial. The younger the woman, the better the chances of success if other indications are present.

Of the author's 296 cases, 70 were not traced. Of the remaining 226 patients, 55 failed to respond to treatment and in 171 menstruation was regulated. Ninety of the latter group became pregnant, and 76 went to term (14 of those more than once) finally giving birth to 101 normal children. In this series, there were 2 cases of ectopic pregnancy and 10 miscarriages; 3 patients miscarried several times. At the present time, 6 patients are pregnant and 1 has had a therapeutic abortion. Two patients were re-treated, at their own insistence, and gave birth to a second child.

[Because of the known adverse effects of irradiation upon a developing fetus, one must be certain that the patient is not pregnant. In a recent article on x-ray irradiation to promote ovulation, J. O. Haman (West. J. Surg. **55:** 107, 1947) points out that x-ray should be given if possible within two weeks of the

previous menstrual period and intercourse eliminated during this time. It is of interest to note that the depth dose as administered by both these authors is approximately 120 r to the ovaries and about 180 r to the pituitary.—S. F. T.] SYDNEY F. THOMAS, M.D.

A Tri-electrode Standard Air-Ionisation Chamber for Roentgen Ray Measurements in r-Units. R. Thoraeus. Acta radiol. **27:** 451–460, May 6, 1946.

The author describes in detail a modification of his previous standard air-ionization chamber (Acta radiol. Supplement 15, 1932). The new instrument makes use of the cylindrical chamber, but consists of a tri-electrode within the electrostatic shield. The two compartments are separated by a 3 mm. lead plate to eliminate the effect of scattered irradiation from the simultaneous irradiation on the two sides. By means of various connections, the new instrument can be used to advantage in measuring half-value layers and calibrating secondary standards and commercial dose meters. After extensive tests, measurements were found to compare favorably with those of the old type and the margin of error in r was about 1.0 per cent.

ELIZABETH A. CLARK, M.D.

RADIOACTIVE ISOTOPES

Radioactive Iodine Therapy. Effect on Functioning Metastases of Adenocarcinoma of the Thyroid. S. M. Seidlin, L. D. Marinelli and Eleanor Oshry. J. A. M. A. **132:** 838–847, Dec. 7, 1946.

Previous studies of the effect of radioactive iodine upon thyroid carcinoma metastases have shown discouraging results. Only those metastases which microscopically show well differentiated tumor will consistently demonstrate sufficient uptake of iodine for treatment to be effective. This report covers studies of the therapeutic effect of radioactive iodine in one case of metastatic carcinoma of the thyroid in which all demonstrable metastases were shown to pick up radioactive iodine. The preparation used contained a mixture, in varying proportions, of the two isotopes I^{130} (half-life 12.6 hours) and I^{131} (half-life 8 days). Both emit beta rays, which produce intense ionization within a few millimeters of tissue, as well as gamma rays, which cause a negligible amount of ionization in the body and are sufficiently penetrating to be readily detected by an external Geiger counter.

The patient, a male aged fifty-seven, had had a thyroidectomy for substernal goiter in 1923 at the age of thirty. The histologic diagnosis was malignant adenoma. He had had no thyrotoxicosis but only pressure symptoms from the mass. No signs of hypothyroidism developed postoperatively and the patient was clinically well for fifteen years. Typical symptoms of thyrotoxicosis then developed, with severe pain in the lower back radiating down the legs. A small pulsating tumor was found in the mid-line of the back at the level of the twelfth thoracic vertebra. Radiographs showed no osseous lesions. A laminectomy in 1939 revealed metastatic adenocarcinoma of the thyroid. The basal rate preoperatively was plus 40 per cent and postoperatively a thyroid crisis developed. Later exploration of the thyroid area showed no thyroid tissue either normal or malignant. Symptoms and signs of hyperthyroidism increased in the following two years and in December 1941 the basal rate was plus 45 per cent. Radiographic study showed evidence of metastases to the lungs, upper part of the right femur, the left second rib, and the left ilium. High-voltage roentgen therapy for a total of 4,060 r over the dorsolumbar area and 3,180 r over the right femur produced no relief from pain.

In 1942 the patient still had pain and evidence of hyperthyroidism. Lugol's solution gave temporary amelioration for several months and then lost its effectiveness. The bone lesions continued to grow and pain persisted. Another course of roentgen therapy was given (3,260 r over the right femur and 1,985 r over the left pelvis), with no relief of pain.

In March 1943 a tracer dose of radioactive iodine was given orally in the form of sodium iodide in water. Geiger counter measurements revealed iodine retention by all known lesions and in two previously unsuspected ones. The first course of radioactive iodine therapy was administered between May and August 1943—a total of 102 millicuries of the 12.6-hour isotope and 20.5 millicuries of the 8-day isotope. The estimated radiation dosage to the tumors was 10,600 equivalent r, and that for the blood was 70 equivalent r. Fractionation of dosage allowed study of the effects on the leukocyte count. After one dose of 40 millicuries of the 12.6-hour isotope, the count dropped from 5,510 to 2,900 in one week, but returned to normal in ten days, even though an additional dose of 35 millicuries was given while the count was low.

The patient gradually improved and by November 1943 the pains diminished, the basal rate dropped to about plus 20 per cent, and there was a weight gain of about 15 pounds. No growth of metastases could be demonstrated. Dissection biopsy of a metastasis of the left second rib at this time provided material for radioautographs, determination of the amount of radioactive iodine per gram, and microscopic study. It was found that the position of the radioactive iodine in the tissue, as shown by radioautographs of thin sections, corresponded exactly with the active cellular areas as shown microscopically. It was estimated from these studies that the apparent tumor weight in the patient was 312 gm. The histologic study confirmed the diagnosis and showed the evidence of cellular destruction as well as residual activity.

In 1944, the patient was given a course of thiouracil therapy to check further on the functional nature of the metastases. This produced a striking remission of the thyrotoxicosis with recurrence on discontinuing treatment. Since then, two additional dosages of radioactive iodine have been given using the 8-day isotope. At the time of publication, the patient's general condition was good. He was practically free of pain and he moved freely about the hospital. His basal rate dropped to minus 27 per cent and has remained consistently low. Roentgenograms showed no progression of the metastatic lesions.

Four other cases of metastatic thyroid carcinoma without clinical hyperthyroidism have been studied with radioactive iodine and have shown selective localization in the lesions. Two of these are under treatment with radioactive iodine.

The reviewer believes this report to be of great significance in the therapy of this previously hopeless condition and regrets that space is not available to include many of the interesting details which are found in the original article. BERNARD S. KALAYJIAN, M.D.

Radioactive Isotopes. J. W. Buchta. West. J. Surg. **54:** 467–473, December 1946.

Radioactive Iodine in the Study of Thyroid Physiology. Use of Radioactive Iodine Therapy in Graves' Disease. Saul Hertz and Arthur Roberts. Ibid, pp. 474–485.

A Plan for Analysis of the Biologic Factors Involved in Experimental Carcinogenesis of the Thyroid by Means of Radioactive Isotopes. Saul Hertz. Ibid, pp. 487-489.

The opening paper of this series, read before the American Association for the Study of Goiter in 1946, discusses the basic physics of isotopes and refers briefly to their employment as tracers in biological experiments.

Hertz and Roberts report their results with internal irradiation by radioactive iodine in 29 cases of Graves' disease. By an analysis, over a long period of time, of both their failures and successes, it was found that radioactive iodine, when given in the dosage range of 5 to 25 mc. to uniodinized patients with Graves' disease, having goiters of 60 to 75 gm., is highly effective as a cure in about 80 per cent of cases. The use of ordinary iodine therapy after administration of the isotope is of advantage in the clinical care of these patients and in the economy and safety of the procedure. In 5 cases of the series subtotal thyroidectomy was done, and in all of these, hypometabolism resulted.

The authors consider that in typical cases of toxic goiter, 10 mc. is a safe minimal dosage for adults. "At 15 mc. level, the percentage of cures is acceptable; at doses up to 25 mc. the regularity of cures equals or supersedes that of current surgical treatment after iodine or thiouracil perparation."

The final paper in the group, by Hertz, places on record an experimental approach to the study of cancer of the thyroid with the aid of radioactive isotopes.

EFFECTS OF RADIATION

Fractures of the Femoral Neck Following Pelvic Irradiation. Wendell P. Stampfli and H. Dabney Kerr. Am. J. Roentgeol. **57:** 71–83, January 1947.

Osteoporosis is one of the more conspicuous microscopic findings in radiation osteitis and is extremely significant from the standpoint of irradiation fracture. Vascular absorption plays an important role and is brought about by the persistent dilatation of the vessels in the haversian and Volkmann's canals. Osteoclasts probably play a secondary part in the process. Zöllner (Strahlentherapie **70:** 193, 1941) believed that the osteoporosis following irradiation may be the result of a disturbance in the normal balance between resorption and production of bone on account of the sensitivity of osteoblasts.

Biopsies in 3 of the 12 cases presented by the authors showed osteoporosis as the most outstanding feature in the microscopic sections. Most of the examined tissue was viable. If vascular damage were the predisposing cause of fractures of the femoral neck, it seems likely that more aseptic necrosis of the femoral head would occur. Significant changes in the blood vessels were not seen in the reported cases. The reparative process following irradiation osteitis is generally retarded because of the extensive damage to the surrounding tissues, including the vessels, bone cells, and periosteum.

The 12 patients in this report with irradiation damage to the femoral necks represent an incidence of only 0.87 per cent. Four had bilateral fractures. All had received treatment through lateral fields to the pelvis. About 25 per cent of the dose to the pelvis was given through these lateral fields. The average age of the patients was fifty-six years. Nine gave no history of trauma. In most cases, the first symptom is mild pain in the hip, beginning one or two years after irradiation. Limping is a constant sign. Roentgen examination shows a subcapital zone of mottling. A zone of sclerosis may extend across the neck just distal to the head. Separation and displacement may develop, or occasionally the neck seems to bend. Irradiation changes are also seen in the pubic bones.

The authors feel that the risk of serious skeletal damage has been exaggerated and that the use of lateral fields in the treatment of the parametrium should not be abandoned. The incidence of fracture is low and when it does occur the prognosis is usually good.

CLARENCE E. WEAVER, M.D.

Death from Necrosis of the Bladder, Eight Years After Irradiation for Carcinoma of the Body of the Uterus. H. Olesen. Acta radiol. **27:** 513–516, Aug. 31, 1946.

While the primary and secondary erythemas of the bladder following irradiation are of slight significance, the tertiary reaction is far more serious, leading in some cases to necrosis, with fistula formation, and presenting a difficult problem in therapy. The author reports a case of bladder necrosis in a 70-year-old woman who eight years earlier had received radium and roentgen therapy for a carcinoma of the body of the uterus. At autopsy no evidence of the uterine tumor was found.

Blood Changes in Radiologic Work. Nils G. Nordenson. Acta radiol. **27:** 416–432, May 6, 1946.

Material obtained from blood investigations on 1,566 individuals working with roentgen rays or radium is presented in comparison with similar studies on 450 individuals not so engaged. Blood changes, including leukopenia, granulocytopenia, increased "shift to the left," hypersegmentation and pathologic lymphocytes, eosinophilia and basophilia, tendency toward leukocytosis, polycythemia, and anemia occurred in 52 per cent of the radiologic personnel. Correlation between the degree of protection and the incidence of blood changes was good when the variation in individual resistance was considered. Significant injuries were observed in about 6 per cent of the group. These the author designates as persistent granulocytopenia and leukopenia, combined and pronounced changes in an individual study, hemoglobin of less than 62 per cent, a red cell count of less than three million, a white count of less than 3,000, and a lymphocytosis of more than 60 per cent. No serious case of anemia was seen.

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